LAW AND CONTEMPORARY PROBLEMS

RIVER BASIN DEVELOPMENT

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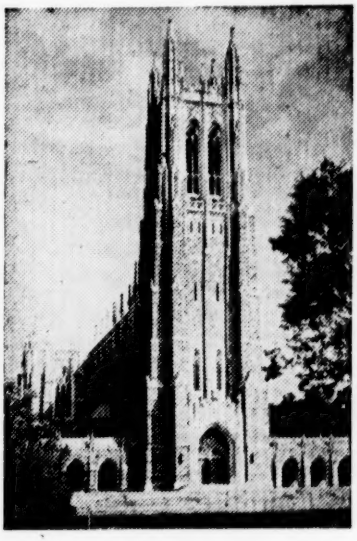

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LAW AND CONTEMPORARY PROBLEMS

VOLUME 22 SPRING, 1957 NUMBER 2

FOREWORD

Although man is far removed from the aquatic environment from which he is said by some to have sprung, his crucial dependence upon water persists. Not alone does water continue to be indispensable to his maintenance of life, but it constitutes as well an absolute condition of his cultural advancement. Thus, only where water supply has been adequate and assured has civilization flourished; where it has been deficient or irregular, growth has been forestalled or arrested.

The importance of water and the necessity for its conservation and prudent utilization have, of course, long and widely been recognized. Only recently, however—perhaps within the past fifty or sixty years—has the river basin come generally to be accepted as the appropriate physiographic unit for planning efficient water resource management. Accordingly, although the concept has lately been translated more broadly into action, almost nowhere has the ideal of fully integrated development yet been attained.

The feasibility of river basin development is a function of many natural factors—topographical, geological, meteorological, and others. Great significance, therefore, attaches to such matters as the size, shape, and location of the basin. Subject to these constant basic limitations, however, the extent to which complete regulation can be realized is determined only by the level of technology—the nature and effectiveness of the means that have been devised and perfected for streamflow control and use.

But beyond these physical considerations, loom complex and troublesome questions concerning the over-all economic and social utility of river basin development: Will river basin development, indeed, induce economic expansion? And if so, how, where, and in what measure? Further, assuming that such expansion occurs, will it invariably entail socially beneficial results, or may it not, perhaps, rather tend to perpetuate or exacerbate existing inequities and maladjustments or create new ones? And if the latter, how, if at all, may such untoward contingencies be tempered or averted?

Moreover, even if these problems can satisfactorily be resolved and river basin development can properly be channeled to conduce desirable ends, there still remains the critical task of comparatively evaluating competing plans so as optimally

to apportion among them the limited resources available. In this connection, several additional questions immediately obtrude: Have appropriate decisional mechanisms, techniques, and standards been evolved? How effective have they been in operation? If shortcomings or abuses have attended their employment, may these possibly be mitigated? And, if not, do any alternatives recommend themselves for adoption?

Finally, of paramount importance is the nature of legal context within which river basin development must transpire: What water rights and associated doctrines govern this area? Are they responsive to underlying policy needs? And, in this light, what modifications and improvements, if any, would be desirable?

To a discussion of these and other related matters, this symposium is addressed. It may well, perhaps, afford illuminating insights into some of the compelling problems that inhere generally in long-range economic and social planning in a democracy—and, if so, the editor and contributors will be gratified. They will feel more than amply rewarded, however, if this symposium will merely have stimulated serious reflection concerning water resource management and, thus, albeit somewhat indirectly and in but a small way, helped soundly to shape water resource policy decisions that will profundly affect our lives for years to come.

MELVIN G. SHIMM.

A PERSPECTIVE OF RIVER BASIN DEVELOPMENT*

GILBERT F. WHITE†

I

INTRODUCTION

The river systems of the world flow today with only a small proportion of their total volume harnessed and applied for human good. With the exception of a few small drainage basins in arid regions, the water of no stream has been fully regulated or used. There are physical limits to such regulation and use, but the degree to which those limits are approached is related to conditions which are partly technological, partly economic, partly political, and partly ethical.

Using the concept of integrated river basin development, each major network of streams draining the land masses of the earth may be viewed as the backbone for a possible planned use of a unified system of multiple-purpose and related projects to promote regional growth. This view of river basin development has come, during the past sixty years, to be employed rather widely as a technical tool for achieving social change. It has found imaginative support, and it appears to be on the threshold of wider application. How much further it wisely may be applied would seem to depend, in part, upon sharpening of our knowledge as to its utility and implications as a tool. Like any tool, it is not inherently good. Its value must be judged in terms of the growth and changes it can effect and upon its flexibility and precision.

The concept of river basin development is used here to mean three component ideas having separate roots in western civilization but coming to be associated with each other in present-day theory and practice. In addition, at least two other ideas have been related in varying circumstances, and it now is possible to suggest a definition of the tool on which there is relatively common agreement in practice.

Before examining the evolution of that concept, it may be helpful to identify the broad limits to river basin development and the distinguishing characteristics of river systems.

A. Limits and Degrees of Development

Although the Nile and Tigris-Euphrates Valleys cradled the early civilizations of the eastern Mediterranean and still support their basic irrigation agriculture, and although the flows of the Rhine, the Ohio, and the Thames long have been essential to the industrialized populations along their banks, it would be inaccurate to regard

* The author is indebted to Edward A. Ackerman for helpful criticism of the manuscript.

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any of them as having attained a high degree of development by contemporary standards of river regulation. Development implies at least two physical changes in stream flow. One is the regulation of flow by storage, diversion, or land management so that the water is available when and where needed, rather than as dictated by natural fluctuations over days, seasons, and years. The other is the use of the water to maximize returns from other resource use. Under this definition, no stream can be considered fully developed unless, over long periods, its flow has been so regulated as completely to serve whatever purposes can, on grounds of social needs and economic growth, be shown to be important to the society involved. Only a few drainage basins are free from annual periods of water deficiency.[1] The ideally regulated stream would fluctuate in its main channels only to meet fluctuating human demands, the natural variations having been evened out.

The engineering means—dams, diversion canals, water-spreading devices—are available to carry out such regulation in most, but not all, situations. In some areas, because of special conditions, such as unstable foundations in deltas, no engineering solution is known to problems of controlling river flow.

Whether or not regulation is possible under prevailing technology, however, the physical limits to such regulation may be estimated with modest accuracy. For example, the total amount of electric power which a stream is capable of generating may be calculated: the amount of power is a function of volume of natural flow, fall, and regulation. It is possible, as well, to calculate the total acreage of land which may be irrigated from a stream, if fully regulated, taking into account the consumptive use made by different assumed crops and cropping practices. The consumptive use of water by animal and human populations also may be computed, but such uses are only a small proportion of the water withdrawn for rural and urban purposes. Typically, more than ninety per cent of water employed in a municipal system is used nonconsumptively—that is, returned to a stream or aquifer, but with some change in chemical quality. The theoretical limit to the amount of nonconsumptive use for urban purposes is very high, so long as appropriate means of purification, waste treatment, and recycling are assumed to be available. Similar considerations apply to the use of water for navigation, wildlife, and recreational purposes, although in those cases, the loss of water by evaporation from reservoir and stream surfaces or by transpiration from plants may be heavy.

Every stream, accordingly, has a definite maximum potential output of hydroelectric power and maximum possible consumptive use of water. But the use which is made within those limits depends upon the complex interworking of factors affecting the particular technologies and uses which will be employed. For example, the decision to generate electric power at a given site is influenced by the engineering feasibility of alternative designs, costs of construction, alternative means of generating power, opportunities for marketing, availability of capital, investment alternatives,

[1] A basin may have a large stream flow and still suffer a deficiency of water for crop or processing needs. The amount and duration of this deficiency in humid areas is greater than is commonly recognized. See C. W. THOMTHWAITE AND J. R. MATHER, THE WATER BALANCE (1956).

availability of labor force, accessibility of construction materials, and organization to plan and carry out the project. These and other factors will be discussed elsewhere in this symposium. It is important here only to note that the degree to which the ideals of full regulation and full use are approached is a function of those factors.

Thus, the actual accomplishment in the Nile or the Tigris-Euphrates or the Rhine falls far short of full regulation or full use. Several lower right-bank tributaries of the Rhine probably are more nearly regulated and used than any other humid or subhumid drainage area. A population of approximately 4,700,000 gains its livelihood from mining, heavy industry, and associated activities in a drainage area of 5,437 square miles. The waters of the Emscher, Lippe, Ruhr, and Wupper are handled by an intricate system of works, including storage reservoirs, diversion tunnels, collection sewers, city and industrial waste-treatment plants, channel improvements, pumping plants, channel dams, and hydroelectric installations. Water from one channel reservoir is pumped back to the upper reservoir at night to serve again during the daytime, and in periods of low flow, the water may be used several times. The responsible authorities are, however, looking forward to much more intensive development.[2] The physical limits of development are being approached, but they have not been reached.

The exceptions—the streams with more nearly complete regulation and use—are those, such as the upper Salt, in Arizona, where the storage structure in an area of heavy and chronic water deficiency halts all flood flows and fails to yield enough reliable supply to meet irrigation commitments.

What is true on a small scale for these highly developed tributaries is true on a vast scale for the major drainage basins of the world. Even the Tennessee is not completely developed. While its main navigation channel has been assured and an intricate system of reservoir regulation has been perfected, it still could have a flood high enough to damage low-lying portions of Chattanooga, and the planned management of some tributaries has only begun. The great rivers typically have flood peaks which reach the sea unused, leaving behind a muddy trail of damage. Their low flows still hinder economic life in times of unusual drought. In many of them, fruitful uses are precluded by lack of regulation or by unsatisfactory bacterial or chemical quality. The gap between what is technically attainable and what exists is everywhere large, although smaller in a few streams of Europe, Asia, and the United States than elsewhere. There seems little doubt that in every basin of more than 2000 square miles drainage area and in many smaller ones, there is the physical possibility of evening out flow by further storage, of decreasing the pollution of waters, and of readjusting upstream land use so as to reduce unnecessary soil loss and make wiser use of water. The social feasibility of such water and land management is, of course, a separate problem.

[2] See Pruss, *Wasserversorgung und Abwasserbeseitigung im Ruhrgebiet auf genossenschaftlicher Grundlage*, in ORDNUNG UND PLANUNG IM RUHR, RAUM 58 (1951); Goepner, *Die Wasserversorgung des rheinisch-westfaelischen Industriegebeits*, in GEOGRAPHISCHES TASCHENBUCH 306 (1956).

Before generalizing further about either the idea or the practice of river development, however, it is in order to offer a word of caution as to rivers themselves.

B. No Two Rivers Are the Same

If there is any conclusion that springs from a comparative study of river systems, it is that no two are the same. Each river is distinctive in characteristics of basin and flow. And rare are the streams that, regardless of size, are homogeneous within their own drainage areas.

The essential elements in a stream system are the river channels, the soils and aquifers by which water reaches the channels, and the flowing water itself. At any one time, the channel section, the contributing slopes and aquifers, and the stream flow bear definite, but not fully measured, relationships to each other, and these relationships change as the volume and quality of water in the stream change. For a true picture of a river, it thus is necessary to describe not only its condition at a given time, but its changes from day to day, from season to season, and from year to year. It is possible to measure, for example, for any stream:

channel cross-section at representative points,
channel gradient for the entire stream and by reaches,
length of channel,
angle of junction of tributaries,
density of tributaries,
area of the entire drainage basin and tributary basins,
shape of the entire drainage basin and tributary basins,
flow of water,
mineral and biological content of water,
slope and soil condition of tributary land surface, and
slope, permeability and thickness of contributing aquifers.

When any one of these characteristics is examined, an amazing range is found among the streams, and no two are found to be precisely the same. Adequate explanation of differences in flow behavior under different conditions of land use, for example, is complicated and is not entirely practicable in our present state of knowledge. Knowledge of origin and flow of sediment in suspension is even less complete.

The point here is that streams are unique combinations of natural features whose processes follow principles for the most part known. They cannot be regarded as interchangeable, and while they may be grouped into broad classes according to their combinations of characteristics, the planning of their development always involves a new, adventurous exploration for each stream, revealing differences in flow, channel, sediment, and chemical quality.

II

CENTRAL IDEAS IN RIVER BASIN DEVELOPMENT

The concept of integrated river basin development, as it has come to be used by

many scientists, engineers, and statesmen around the world today, seems to consist in three associated ideas. These are the ideas of the multiple-purpose storage project, the basin-wide program, and comprehensive regional development. They took shape over more than half a century, forming side by side, each drawing stimulus from a different set of conditions, but not clearly combining into single programs in the United States until the middle 1930's. They still are far from finding full expression in many areas of water and land resources activity. Their combination is more an ideal than a reality, but it is an ideal which recurs in differing form so frequently and widely and which commands such warm enthusiasm as a symbol in public thinking that it should be reckoned with as a unit.

Others ideas have entered into the arena of public action, sometimes figuring prominently, and these also should be considered. The idea of articulated land and water programs is one such line of thought. The idea of unified basin administration is another. These are less persistent and influential in the work undertaken thus far, however, and appear to have played a secondary role.[3] This review deals primarily with the United States, but it outlines some of the more influential changes in other countries.

One hundred years ago, Humphreys and Abbot, in making the first monumental survey of flood problems in the lower Mississippi Valley, could be comfortable in dismissing remedial reservoir work on tributaries as unimportant or relating only to low-water navigation and in limiting their detailed recommendations to the main stem of the river.[4] Engineers for irrigation works in Egypt or India could feel warranted in putting forward single projects to serve single purposes.[5] Whenever man was dealing with rivers, he was touching them at a particular point for a particular purpose and, with the exception of a few far-seeing men, like Powell and Willcocks, rarely dreamed of laboring with the whole river for multiple purposes.

By 1900, however, three new ideas had begun to emerge and to receive discussion. They were slow in finding acceptance, and it was several decades before all had been

[3] Various definitions of the same general complex of ideas are current. The Bureau of Flood Control of the Economic Commission for Asia and the Far East uses "multiple-purpose river basin development" to include multiple-purpose use, unified development of entire basins, social benefits and costs applied to a region, comprehensive development of all resources, and unified control. ECONOMIC COMM'N FOR ASIA AND THE FAR EAST, MULTIPLE-PURPOSE RIVER BASIN DEVELOPMENT pt. 1, at 1-8 (U.N. Pub. Sales No. 1955.II.F.1). It draws, in part, from the report of the President's Water Resources Policy Commission, whose legal staff defined comprehensive development of water resources as "basin-wide development for optimum beneficial uses of a river system and its watershed." PRESIDENT'S WATER RESOURCES POLICY COMM'N, WATER RESOURCES LAW 383 (1950). A common variation is illustrated in ROY E. HUFFMAN, IRRIGATION DEVELOPMENT AND PUBLIC WATER POLICY 153 (1953): "A comprehensive development program for a river valley involves working with three resources of equal importance—water, land and people. In the past, water has tended to receive major emphasis, while the other two factors played a minor role or were disregarded altogether in project and program formulation."

[4] A. A. HUMPHREYS AND H. L. ABBOT, REPORT UPON THE PHYSICS AND HYDRAULICS OF THE MISSISSIPPI RIVER 406-11 (2d ed. 1876). They considered, but dismissed as inapplicable, the plans of French and Italian engineers and of the Americans, Ellet and Morris, for reservoir systems.

[5] WILLIAM LUMSDEN STRANGE, INDIAN STORAGE RESERVOIRS WITH EARTHEN DAMS iv (1904); and G. W. MACGEORGE, WAYS AND WORKS IN INDIA 107-215, 431-42 (1894).

translated into action in an appropriate scale. Today, they still await a full and thorough demonstration in a single area.

A. Multiple-Purpose Storage

Hoover Dam, on the Colorado River, is a conspicuous example of a form of engineering design which uses a single structure to store water for multiple purposes.[6] A concrete gravity dam, with a height of 726 feet and a mass of 3,250,000 cubic yards, it blocks the flow of the Colorado in the Black Canyon, providing sufficient storage and accompanying structure to assure that the flow can be fully controlled below that point to serve four major uses. The stored water may be diverted downstream to irrigate farms in the Imperial and Coachella Valleys of California. It also is diverted to serve the residential, agricultural, commercial, and manufacturing needs of Southern California to the extent of 1,500 cubic feet per minute. The water released through the dams is used to generate electric power, which is marketed as falling water to the states of Arizona and California and to the city of Los Angeles. A part of the reservoir storage, approximately 9,500,000 acre-feet, is reserved for the control of peak floods, so as to prevent them from traveling on downstream, where damage, chiefly to the Imperial Valley, might result from the river going over its banks. In addition to these four objects of irrigation, municipal water supply, hydroelectric power, and flood control, the dam was designed to help maintain a flow of water for navigation in the lower channel. Navigation has only theoretical importance, the theory, however, being a crucial one, in as much as the improvement of navigation formed the ostensible constitutional peg upon which federal action in undertaking a project of this magnitude first was hung.

Hoover Dam was authorized under the Boulder Canyon Project Act of 1928,[7] upon the basis of an interstate compact first concluded by the states of the Colorado basin in 1922[8] for the allocation of the waters of the basin, but it was not finally ratified with reservations by the requisite number of states, Arizona refraining, until 1929. Its design had begun in preliminary form on the drafting tables of the Bureau of Reclamation engineers ten years earlier, when the first intensive studies were made of the possibility of harnessing the river, and they applied to a monumental problem the fruits of their experience with many smaller, less complicated river projects in the western states.

When Hoover Dam was authorized, there were in the world few conspicuous examples of a large multiple-purpose storage project. There were numerous projects at which two or three purposes were served, most of them not involving storage. The storage projects were chiefly in western Europe and western United States. In the Ruhr-Westfalian area, there was a series of seventeen smaller dams constructed around the turn of the century to store water for industrial and municipal supply, to gen-

[6] See PAUL L. KLEINSORGE, THE BOULDER CANYON PROJECT (1941).

[7] 45 STAT. 1057, 43 U.S.C. §617 (1952).

[8] Signed at Santa Fe, New Mexico, Nov. 24, 1922, pursuant to Act of Aug. 19, 1921, c. 72, 42 STAT. 171, approved by Congress, Act of Dec. 21, 1928, c. 42, 45 STAT. 1064, 43 U.S.C. §617l (1952).

erate power, and to reduce floods.[9] Mill dams had provided water for industrial processing as well as to turn water wheels, and in some instances, they stored water for municipal purposes, but they typically were single-purpose and small in height.[10] With the coming of long-distance electricity transmission in 1891, electric power began to be linked with other purposes. Thus, in the United States, the Bureau of Reclamation combined electric power and irrigation storage at the Minidoka Dam on the Snake River in 1909 and at the Roosevelt Dam on the Salt River in 1911.[11] And the Hetch Hetchy water supply, with its controversial use of National Park lands to aid in furnishing municipal water and power for San Francisco, had commanded public attention from 1913 until construction began in 1924.[12]

Nowhere in South America, Asia, or Africa was there a major multiple-purpose storage project. This is not to say, of course, that there were no combinations of two or more purposes in water storage or that the concept of multiple use was not current in public thinking. The irrigation barrages constructed under British supervision in India as a measure of famine prevention in drought areas had provided for some use of water for domestic purposes, a use ever common where water is conducted through a dry area, and their irrigation canals had been used for navigation where suitable. Engineers, using the new knowledge of electricity, had sought to install power turbines where water fell through conduits to supply municipal needs. And a few river canalization schemes had installed generators in connection with navigation locks, thus capturing the energy otherwise lost. In eastern Asia, too, works on the lower stretches of streams combined navigation or flood control with irrigation.

A different form of multiple-purpose project, not involving storage, however, had already taken shape in the lower reaches of a few navigable streams, such as the Seine, the Po, and the Mississippi, where, by the construction of cutoffs, deepened channels, or training works, it was practicable both to improve the all-season navigability of channels and to hasten the flow of floods, thus reducing the area and depth of flooding. Likewise, the Dutch and English engineers, operating along their coasts and in the English Fens, had, as early as the seventeenth century, devised schemes which would dispose of flood waters and reclaim land for agriculture through subsidiary drainage. Strictly speaking, drainage goes hand in hand with flood control wherever the latter is practiced by channel regulation, and the Yazoo and the Chao Phya provide excellent examples of this.

In all these countries, the vision of multiple-purpose development was far ahead of the practice. By 1890, Sir Wilfred Willcocks was dreaming of dual-purpose dams on the Nile—indeed, a system of them—and viewed his design for the low Aswan structure as the precursor for what might follow on a large scale.[13] A German engi-

[9] See INTZE, ENTWICKELUNG DES THALSPERRENBAUES IN RHEINLAND UND WESTFALEN VON 1889 BIS 1903 (n.d.).

[10] See LEFFEL'S CONSTRUCTION OF MILL DAMS AND BOOKWALTER'S MILLWRIGHT AND MECHANIC (1881).

[11] Bureau of Reclamation projects are described in its *Dams and Control Works*, various editions.

[12] For a recent review of the controversy, see *Hearings before the Committee on Public Lands of the House on H.R. 5964*, 77th Cong., 2d Sess. (1941) (amending the Raker Act).

[13] W. WILLCOCKS, THE NILE RESERVOIR DAM AT ASWAN AND AFTER 13-26 (1901).

neer, Mattern, using the work of Intze and others, was pleading in 1902 for multiple-purpose projects as the key to more intensive water use.[14] Similar thinking is also to be found in the report of the United States Inland Waterways Commission in 1908, which, while deeply concerned with problems of public-private responsibilities for water transport and water power and with coordination of federal activities, recognized the possibilities of combining irrigation, navigation, power, flood control, water supply, and related purpose in the same programs.[15] And writing in 1915, the Professor of Civil Engineering at Harvard was saying about water power:[16]

> This power arises from the water flowing in a stream, but this stream affords other uses, as for irrigation, water supply, and navigation. For the proper conservation of the water in a stream, all these four uses must be considered. Its development for one purpose must, so far as possible, be consistent with its development for the others. All should be developed so as to be productive of the greatest total good. The four uses above referred to are inseparably connected; particularly so are the two uses of a river for water power and for purposes of navigation, in cases where both of these uses are economically practicable.

In view of the early articulate championing of multiple-purpose approaches, it may be asked why a project such as Hoover Dam did not materialize sooner. Part of the explanation rests upon the perfection of engineering techniques. Multiple-purpose storage design generally means larger structures, and these require refinements of foundation treatment and mass design in order to carry the larger load. Concrete was not adapted to dams of large height until the early 1900's, and then it remained for Arrowrock Dam in 1915, with a height of 354 feet, and, by way of culmination, Hoover Dam to perfect the means of pouring large blocks as much as sixty feet across.[17] The method of rolling raw earth into great structures, such as at Ft. Peck on the Missouri, was not developed until later years, for while it is cheaper in materials, it depends for its economy upon large-scale earth-moving machinery and for exact knowledge of methods of handling soil foundation materials, which did not become available until the 1920's.[18] Until some of those new techniques were in use, the building of large earth dams, particularly on streams in semiarid or arid regions, was a hazardous occupation.

[14] E. MATTERN, DER THALSPERRENBAU UND DIE DEUTSCHE WASSERWIRTSCHAFT 100 (1902).

[15] Inland Waterways Comm'n, *Preliminary Report*, S. Doc. No. 325, 60th Cong., 1st Sess. 18-25 (1908). M. O. Leighton's "Relation of Water Conservation to Flood Prevention and Navigation in Ohio River" is an appendix, *id.* at 451-90, critically reviewing the opposition to the Ellet plan for reservoirs. Ellet's plan for a reservoir system on the Ohio was hailed by his publisher in 1853 as "the foundation of a new branch of engineering, which, in the progress of the country in wealth and population, is destined to acquire increasing interest from year to year." CHARLES ELLET, JR., THE MISSISSIPPI AND OHIO RIVERS vii (1853).

[16] GEORGE F. SWAIN, CONSERVATION OF WATER BY STORAGE 24-25 (1915).

[17] U. S. BUREAU OF RECLAMATION, DEP'T OF INTERIOR, DAMS AND CONTROL WORKS 7-10, 49-51 (1938). Willcocks, in his design of Aswan, saw it as marking a new "epoch in dam building," especially as the use of concrete might come to be perfected, but he thought of the typical combination of purposes as being flood control and irrigation. WILLCOCKS, *op. cit. supra* note 13, at 4.

[18] The Miami Conservancy District pioneered with draglines for building hydraulic fill dams with clay cores. The pioneering worker on the physical properties of soils as applied to engineering was Karl Terzaghi. Smaller earth dams had been constructed over at least 1,600 years in India and the Middle East.

Other factors than dam design and construction also were at work. Perhaps most important, improvement in methods of long-distance transmission of electricity was rapid between 1900 and 1925, so that a line of 100 miles, considered uneconomic by operating companies in 1910, seemed short by comparison with the 200-mile line which the Southern California groups were prepared to build to Hoover Dam in 1929. Power clearly was the most readily vendible of all the products of multiple-purpose dams: municipal water supply might warrant heavy investment, but it was not as easily distributed and sold. Once cheap transmission became practicable, the active market for power for residential and industrial use grew at breath-taking speed. For many projects, the combination of vendible power made attractive an enterprise that otherwise would have commanded little attention if solely for irrigation or flood control.[19] Electricity generation played a major role at Hoover Dam, in the pioneer French plans for the Rhône in 1933, and for the larger multiple-purpose structures in India, such as the Bahkra Dam on the upper Sutlej.

The private power companies in the United States, however, vigorously opposed the incorporation of power-generating facilities in public water-storage facilities. Threat to their monopolistic position under public franchise was one consideration in their opposition, which also stemmed from a deep concern with the constitutionality of direct government action in power generation. The moment that it was proposed to combine power generation with a purpose such as navigation, which was the exclusive function of the federal government, complications arose, because the private companies obviously could not be expected to take direct responsibility for navigation or flood control or noninterest-bearing reclamation projects. On their side, the advocates of public power opposed any grant of authority to private companies to develop power in single-purpose projects on streams under public control. The General Dam Act of 1906 was the first broad legislative effort in the United States to deal with the conditions in which nonfederal development might take place on navigable waters and gave special attention to preventing interference with navigation and fish movement.[20] There followed a long controversy culminating in the Federal Water Power Act of 1920, with its much more precise regulation of nonfederal development.[21] The issue was both federal and state, having been drawn, for example, in 1908 in New York, when the State Water Supply Commission proposed public construction of a dam on the Sacandaga River to reduce floods and produce electric power.[22]

Opposition also was supported by inertia in design and by the widely held view

[19] This view of electric power as the integrating factor in river basin development was widely preached by Morris L. Cooke. See Cooke, *Multiple-purpose Rivers*, 237 J. FRANKLIN INST. 251 (1944). See also Lepawsky, *Dams and Democracy*, 29 VA. Q. REV. 533 (1953).

[20] 34 STAT. 386.

[21] 41 STAT. 1063, as amended, 49 STAT. 838 (1935), 16 U.S.C. §§791a-825r (1952). This history is described in PRESIDENT'S WATER RESOURCES POLICY COMM'N, *op. cit. supra* note 3, at 391-408 (1950).

[22] STATE WATER SUPPLY COMM'N OF NEW YORK, STUDIES OF WATER STORAGE FOR FLOOD PREVENTION AND POWER DEVELOPMENT IN NEW YORK STATE UNDER PUBLIC OWNERSHIP AND CONTROL 14-15, 18 (1908).

that on grounds of design safety and economy, it often was impracticable to combine power with certain other purposes. Thus, an examination of a dozen civil engineering textbooks published during the first three decades of the century shows little or no attention to multiple-purpose design. And a special committee of the American Society of Civil Engineers, in its progress report on Mississippi River flood problems, in 1916 stated:[23]

> There is a popular delusion that the same reservoir can be utilized simultaneously to reduce floods, increase the low-water discharge of a stream, and increase the water-power that can be developed therefrom, but ordinarily its utilization for any one of these purposes precludes its efficient use for either of the others. . . . Your committee, however, does not intend to condemn in toto the utilization of reservoirs for more than one purpose. In fact, it believes that the practical solution of the flood problem in some valleys will be found in permitting corporations to build reservoirs in which a portion of the stored water can be utilized to a limited extent for power purposes and the remainder for flood prevention. . . .

One of the standard texts on water-power engineering was still taking a somewhat similar position ten years later.[24] The single-purpose approach persisted. Perhaps the extreme public demonstration was in the case of the Miami Conservancy District, where, under a new Ohio state conservancy law following the tragic flood of 1913,[25] the District constructed a system of channel improvements and five detention reservoirs to prevent any repetition of peak floods. The reservoirs were designed to detain water only long enough to permit the outflow to be limited to bank-full capacity downstream. On each dam was placed a plaque reading as follows:[26]

[23] *Hearings before the Committee of the House on Flood Control on Mississippi River Floods*, 64th Cong., 1st Sess. 295-96 (1916). One of the members, Morris Knowles, dissented, calling this statement "an entirely unnecessary and unfair discussion purporting to show that reservoirs cannot be made useful for flood prevention, together with other purposes; whereas we know, on the contrary, that, notwithstanding all these statements, it is possible to operate reservoirs with several purposes in view, and that is actually done in some of the great reservoir systems of Europe and America without conflict of interests." *Id.* at 301.

[24] "Storage capacity below spillway level cannot be devoted to both power and storage unless at all times some portion at the upper level is reserved for flood use and kept empty, and, therefore, always ready for the flood emergency. In this country such joint use of reservoirs has not been attempted, their purpose always being water storage for power, municipal water supply, or navigation, so that any decrease of flood tendencies has been merely incidental." H. K. BARROWS, WATER POWER ENGINEERING 180 (1927).

[25] Act of Feb. 17, 1914, OHIO REV. CODE ANN. c. 6101 (Page 1954).

[26] ARTHUR E. MORGAN, THE MIAMI CONSERVANCY DISTRICT 473 (1951). In passing, it may be noted that one of the paradoxes in river basin development history is that the head of the Miami Conservancy District at that time was Arthur E. Morgan, who later became a member of the first board of the Tennessee Valley Authority and a proponent of a multiple-purpose reservoir system for the entire Mississippi; while a leader in the negotiations culminating in the dam on the lower Colorado was Herbert Hoover, then Secretary of Commerce, who later came to oppose expansion of federal power activities in favor of private management of these resources. Hoover never shifted his basic position on the desirability of linking private power with public management of other resources, but he did find himself, as late as 1955, trying to stem a tide of public power activity which had taken strong impetus from the apparent success of Hoover Dam. See 1 COMM'N ON ORGANIZATION OF THE EXECUTIVE BRANCH, WATER RESOURCES AND POWER 119-22 (1955).

The Dams
of the Miami Conservancy district are for
Flood Prevention Purposes
Their use for power development
or for storage
would be a menace to
the cities below

For twenty years after 1908, there were recurring federal authorizations of water-resources studies, in which the surveying agency was directed or permitted to consider other uses in addition to the major purpose in view. Thus, the Bureau of Reclamation was authorized to investigate power and later municipal water supply,[27] the Corps of Engineers was authorized to consider power in connection with navigation and then flood control,[28] and the Federal Power Commission was to take those other uses into account in reviewing applications for power-site permits.[29] These did not specify the kind of report which was expected, however, and the agencies regarded them more as permissive than directive. Accordingly, water-pollution control was neglected throughout those decades; and although attention was given to preservation of fish life at dams early in the period, as the size of projects increased and competition between federal agencies also increased, the interests of recreation, wildlife habitat preservation, and esthetic enjoyment of wilderness lost out, and the conservation groups had to fight hard to gain any serious consideration from the engineers.[30]

The period of emergency public works in the United States in 1933-39, however, gave occasion for broad application of the multiple-purpose project idea across the country. Aided by substantial grants and loans in the interest of relieving unemployment, a whole series of new dams combining two or more purposes was constructed. They were favored, in principal, by the reviewing agencies; they offered the most widely distributed direct benefits; and they lent themselves particularly to public agencies, the only ones which could qualify for the public subsidy. In addition to the Tennessee Valley Authority, the Bureau of Reclamation launched the Grand Coulee, Central Valley of California, and Colorado-Big Thompson projects; the Corps of Engineers launched the Bonneville, Fort Peck, and upper Ohio projects; and various state agencies, such as the Nebraska power and irrigation authorities and the Muskingum Conservancy District in Ohio, obtained federal help. The reports of the Mississippi Valley Committee and National Resources Board and their successors gave heavy attention to multiple-purpose storage.[31]

[27] Act of April 16, 1906, 34 STAT. 116-17, 43 U.S.C. §567 (1952). This permission to make provision for water supply and power did not take the form of a directive until Act of Aug. 4, 1939, 53 STAT. 1194, 43 U.S.C. §§485 (1952).

[28] Act of March 3, 1909, 35 STAT. 822, 33 U.S.C. §604 (1952); Act of March 1, 1917, 39 STAT. 950, 33 U.S.C. §701 (1952).

[29] Act of June 10, 1920, 41 STAT. 1068, 16 U.S.C. §801 (1952).

[30] Specific instructions to consider wildlife were contained in Act of Dec. 22, 1944, 58 STAT. 887, and Act of Aug. 14, 1946, 60 STAT. 1080, 16 U.S.C. §§661-66c (1952).

[31] MISSISSIPPI VALLEY COMMITTEE OF P.W.A., REPORT 25-29 (1934); NATIONAL RESOURCES BOARD, REPORT 271-75, 286 (1934).

By 1939, multiple-purpose projects were the order of the day: the idea was accepted and considered practical, and, with the lag in private construction owing to depression conditions, the single-purpose storage project was no longer dominant.

Single-purpose projects were not abandoned, however; they only gave way to multiple-purpose projects in relative weight. Irrigation storage on the upper Rio Grande, flood-control dams on the Yazoo and Muskingum, navigation dams on the upper Mississippi, power dams on the Wisconsin were examples of structures that were considered best suited to serving a single aim. They have continued in relatively diminishing number, often a source of controversy that probably has had fullest recent public expression in the dispute over the development of privately-financed power dams in Hell's Canyon, on the Snake. In 1953, the chief of project planning for the Bureau of Reclamation could say:[32]

> . . . multiple-purpose projects are now thoroughly accepted, and an engineer would be considered remiss if he did not consider all possible uses, in connection with the planning of any irrigation project.

B. The Basin-wide Program

While the idea of multiple-purpose storage was gathering force, there was a complimentary, but not corollary, formation of the idea of basin-wide development. Again, Willcocks, Powell, and others had seen that if regulation of stream flow was to be achieved fully, it could only be by harnessing the flow of an entire drainage basin, and this meant designing control works with a regard to all other works—existing or possible—in the basin. Willcocks had made tentative plans for dealing with the Nile and Tigris-Euphrates basins as unified systems and was aware of, but not discouraged by, the political complications in store.[33] Powell, observing from his studies of the arid and semiarid regions that each stream presented problems peculiar to itself, proceeded to appraise the irrigation possibilities of each basin separately.[34] And President Theodore Roosevelt, in transmitting the Inland Waterways Commission preliminary report, could say:[35]

> Each river system from its headwaters in the forest to its mouth on the coast, is a unit and should be treated as such.

The first major basin in the United States in which this idea was incorporated in a complete design was the Miami basin. There, as already noted, the program was strictly a single-purpose, flood-control effort. New York City, also, had undertaken to deal with entire tributary drainages of the Hudson River in single-purpose development of new water supply at the turn of the century, and while there had been no thought of covering larger areas, the concept of planning for the complete subbasin

[32] John Dixon, *Planning an Irrigation Project Today*, in CENTENNIAL TRANS. AM. SOC'Y CIVIL ENG. 357, 362 (1953).

[33] WILLCOCKS, *op. cit. supra* note 13, at 13-26; W. WILLCOCKS, IRRIGATION OF MESOPOTAMIA (2d ed. 1917).

[34] J. W. POWELL, REPORT ON THE LANDS OF THE ARID REGION 10-14 (1879).

[35] Inland Waterways Comm'n, *supra* note 15, at iv.

had been established.[36] Prior to that time, relatively complete development of small streams for mechanical water power had taken place, but not in accord with a single plan.[37]

The same situation had prevailed in a more acute form along the alluvial valley of the Mississippi, where the multiplication of levee districts and drainage districts without clear relation to a basin-wide program had resulted in direct conflict and oftentimes serious injury among the various works, leading to increased federal participation.[38] It is significant that A. E. Morgan and his associates came directly out of efforts to plan drainage projects in the alluvial valley and had seen the folly of attempting to deal with large flood flows by taking small bites. The Miami, they were determined, was to be handled as a unit.

In the same year that major works were undertaken in the Miami basin, a National Waterways Commission was authorized to prepare a comprehensive plan for the development of the nation's water resources for navigation and every useful purpose and to make recommendations for carrying out such work.[39] War conditions deferred its appointment, however, and it never came to grips with the problems.

In France, the desirability of treating basins as units was recognized in law in 1919,[40] and in Germany and Italy, the concept was accepted by engineers as necessary to effective planning.

But even after the Miami program had been demonstrated, it was a long time before the idea caught on elsewhere in the United States. Clearly, it played a major role in the discussions leading to final authorization of Hoover Dam: the 1922 compact recognized that the waters of the entire Colorado basin would need to be allocated under one agreement and that such allocation might lay the basis for designing works to control and use those waters. It was not sufficiently strong, however, to require that the final design of the first dam should be shown as a part of a system for the full basin. Nevertheless, the idea was finding progressively wider support in engineering circles, and threatening water shortages in western streams lent weight to it.

The great Mississippi flood of , brought this thinking to focus. That catastrophe dramatized the inadequacy of Corps of Engineers' plans, which had sought to control flooding and maintain navigation channels along the main stem without planning works for the tributaries. Only the year before, the Chief of Engineers had reported that all was well with the levee and channel works.[41] A national debate ensued on

[36] See BOARD OF WATER SUPPLY OF THE CITY OF NEW YORK, CATSKILL WATER SUPPLY (1928).

[37] Mill owners did, however, maintain organizations to deal with their interests in an entire stream, and engineers saw the possibilities of large-scale unified development. See, *e.g.*, JOSEPH FRIZELL, WATERPOWER 588-605 (1903).

[38] See ROBERT W. HARRISON, LEVEE DISTRICTS AND LEVEE BUILDING IN MISSISSIPPI: A STUDY OF STATE AND LOCAL EFFORTS TO CONTROL MISSISSIPPI RIVER FLOODS (1951).

[39] Act of Aug. 8, 1917, 40 STAT. 250 (repealed in 1920).

[40] Law of Oct. 16, 1919. See Arbelot and Dupin, *L'evolution des idées en matiere de regularisation de l'energie hydroelectrique*, in 2 TRANS. FIRST WORLD POWER CONFERENCE 150-54 (1924).

[41] U. S. WAR DEP'T, REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY, 1926, pt. 1, at 1793, 1794 (1928).

the efficacy of levees versus cutoffs versus dams versus forests. Many extreme and poorly grounded assertions were made, and out of the heat and confusion, there emerged a few policy agreements. In the River and Harbor Act of 1927, Congress authorized comprehensive examinations and surveys by the Corps of Engineers to formulate[42]

> . . . general plans for the most effective improvement of [navigable streams and their tributaries] for the purposes of navigation and the prosecution of such improvement in combination with the most efficient development of the potential water power, the control of floods, and the needs of irrigation.

This was the second time in American history that a public agency had been directed to make comprehensive studies of navigation, flood control, irrigation, and power for complete drainage basins, but the first to have effect. The "308 reports," as they were known from their areas having been described in House Document No. 308,[43] became the point of departure for river basin development in the United States. Under the authority of the 1927 act, the possibility of multiple-purpose projects for at least four major purposes was recognized, and the comprehension of all parts of the basin in a single report was required. In doing so, it brought together federal concerns that had grown up along four separate lines of navigation, flood control, irrigation, and power policy.

Of the many basin programs that emerged in later years out of 308 reports—the Columbia, the Missouri, the upper Ohio—none commanded more attention than the Tennessee. After the 1927 authorization, the Corps of Engineers decided to concentrate its studies in the early years on one pilot basin. They selected the Tennessee, in part because it seemed to lend itself to unified planning, in part because it was endowed with a relatively generous amount of basic hydrologic data, and in part because the Government was confronted with the difficult decision of what to do with Wilson Dam, a hydroelectric plan at Muscle Shoals which had been constructed during World War I to provide power for manufacture of nitrogen. It was the Corps of Engineers which prepared the first plan for the Tennessee, and when the Tennessee Valley Authority Act was passed by Congress in 1933,[44] the Corps plan was the available one.[45] The new Authority set up its own engineering staff and asked the Bureau of Reclamation to aid in revising the plans so as to design a series of high dams having large hydroelectric output, rather than the moderately low dams designed by the Corps to serve navigation primarily and to produce relatively small

[42] 44 STAT. 1015. The list was prepared by the Federal Power Commission and Corps of Engineers, in accordance with Act of March 3, 1925, §3, 43 STAT. 1190.

[43] H. R. Doc. No. 308, 69th Cong., 1st Sess. (1927).

[44] 48 STAT. 58 (1933), 16 U.S.C. §831 (1952).

[45] H. R. Doc. No. 328, 71st Cong., 2d Sess. (1930). It is doubtful whether or not Congress was aware of the possible implications of the Corps of Engineers' low-dam plan for later high-dam construction at the time that the act was passed. It might have been thought that only one or two new structures (Cove Creek and Wheeler locks) would be built. Later legislation was required to define clearly the authority for river basin planning. See C. HERMAN PRITCHETT, THE TENNESSEE VALLEY AUTHORITY, A STUDY IN PUBLIC ADMINISTRATION 3-47 (1943).

amounts of power. Thus, the Tennessee basin was the first to be studied with a view to designing a single, unified program, and it was the first in which such a program was authorized for construction. As the TVA worked out its revised designs over the years, it developed a program under which there are twenty-seven dams serving navigation, flood control, and hydroelectric power, operated so as to regulate flow throughout the main stem and major tributaries and to contribute to reduction of flood flows in the lower Mississippi. From the standpoint of historical evolution and of popular regard, the TVA may be considered the prototype for unified basin-wide programs of multiple-purpose projects. It was intended to demonstrate the feasibility of such programs, and it clearly has done so.

Throughout the late 1930's, the National Resources Committee and its successors promoted thinking among both federal and state groups on the meaning of drainage basin plans by drawing them together to assess needs and to attempt to agree upon unified programs of investigation and construction.[46] Several significant basin-wide programs already were on the drafting boards about the time that the TVA took shape. One of these was the Rhône plan, which had its inception in the device of French engineers to combine further navigation improvements with power generation.[47] In Spain, a national survey of water resources had recommended unequivocally in 1933 for the treatment of rivers as units.[48] The Central Valley plan in California had been proposed as early as 1921 and was authorized by the state in 1933, but awaited federal financing.[49]

There is little doubt that all the integrated systems of multiple-purpose projects attempted since the 1930's were influenced in some degree by the TVA, Columbia River and Central Valley works. Probably more important than the direct connections, of which there are many, has been the fact of accomplishment, the patent demonstration that what engineers around the world had been describing as possible and feasible could be built and operated in a relatively short time.[50]

C. Comprehensive Regional Development

The third of the major ideas in unified river development is more difficult to describe than the other two, because it has not been fully realized in any part of the earth. There is no prototype, no sterling demonstration of the idea; only partial, incomplete ventures in a direction that is, thus far, obscure. Implicit in the Hoover Dam project and in the TVA was an aim that, while assumed in much federal resources activity for more than a century, was not explicitly stated in the legislation and has not been fully realized. It was the aim of so planning and carrying out the

[46] See NATIONAL RESOURCES COMMITTEE, DRAINAGE BASIN PROBLEMS AND PROGRAMS (1936). See also revision of committee reports in 1937.

[47] See GILBERT TOURNIER, RHÔNE: DIEU CONQUIS (1952). Planning had been authorized by an act of May 27, 1921, and an administrative order of Jan. 13, 1931.

[48] PLAN NACIONAL DE OBRAS HIDRÁULICAS (1933).

[49] See HUGH G. HANSEN, CENTRAL VALLEY PROJECT: FEDERAL OR STATE? 21-37 (Cal. Assembly Interim Comm. Rep., Vol. 13, No. 6, 1955).

[50] See TVA, TVA AS A SYMBOL OF RESOURCE DEVELOPMENT IN MANY COUNTRIES (1955).

works for river regulation and use that the region in which the basin is located would enjoy maximum practicable stimulation of its economic and social growth.[51]

The roots for such concern seem to go deep in United States public works and public land development. Gallatin's plan for waterway improvement, Powell's program for treatment of the arid lands, and Newland's early pleas for federal subsidy to western irrigation had presumed wise use of public material resources or capital to stimulate economic growth.

To take our two examples, the Hoover Dam was recognized by its proponents and opponents as likely to promote economic growth in the lower Colorado basin and in Southern California as well, although it was not specifically designed to effect such growth in a particular way. The Tennessee Valley projects were believed to be beneficial in sparking growth of what had been regarded as a backward and depressed region, but beyond this hope and the direction, given at the last hours in framing the act—[52]

> Sec. 22 To aid further the proper use, conservation, and development of the natural resources of the Tennessee River drainage basin and of such adjoining territory as may be related to or materially affected by the development consequent to the Act, and to provide for the general welfare of the citizens of said areas, the President is authorized, by such means or methods as he may deem proper within the limits of appropriations made therefor by Congress, to make such surveys of and general plans for said Tennessee basin and adjoining territory as may be useful to the Congress and to the several States in guiding and controlling the extent, sequence, and nature of development that may be equitably and economically advanced through the expenditure of public funds, or through the guidance or control of public authority, all for the general purpose of fostering an orderly and proper physical, economic, and social development of said areas . . . —

the Authority was not explicitly designed to occupy itself with those questions. Research on the impact of navigation upon industrial life, or on the relation of retail power rates to domestic electricity consumption, or on the efficiency of various cropping and fertilizing methods was undertaken to supplement and make more effective the water resources and fertilizer projects, rather than as a basis for deciding what form of project should be undertaken, where, and when. Repeatedly, the officers of the TVA, from its earliest years, noted with satisfaction the effects of their activities upon the economy of the area loosely described as the "TVA Region" or the "southeastern region." This was summed up most recently by Gordon Clapp, who pointed to increase in nonagricultural employment, increase in variety of economic opportunities, rapid growth of high-wage industries, a new pattern of industries process-

[51] The term "region" is used here in its broadest sense to include any area designated for study or action. For discussions of more precise uses, see NATIONAL RESOURCES COMMITTEE, REGIONAL FACTORS IN NATIONAL PLANNING AND DEVELOPMENT (1935); and Platt, *Discussion: Nature and Scope of Regional Science*, in 2 PAPERS AND PROC. REGIONAL SCIENCE ASS'N 46 (1956).

[52] 48 STAT. 69 (1933), 16 U.S.C. §831u (1952). The broad, regional studies were not undertaken at once, but they followed soon, and the legislative authority was sufficiently general to permit their being undertaken. Ackerman, *Tennessee Valley Authority Planning: Methods and Results*, in PAPERS OF INT'L CONFERENCE ON REGIONAL PLANNING AND DEVELOPMENT (1955), gives a careful review of the development of those activities.

ing raw materials, electrification of farms, and rural self-improvement projects as indices of growth stimulated by the Authority.[53] The stimulation of local citizen participation in valley improvement is counted both as essential to and an important outcome of unified regional development activities.

In both the Hoover Dam and TVA examples, regional effects were intimated but not planned, then enjoyed but not managed. They were dimly perceived at the start, hailed when apparent, and the subject of earnest study after the crucial decisions as to major river regulation works had been made. In each case, the criteria for selection and financing of the construction work were restricted to a showing of feasibility for the stated purposes of water control. Such gauges of economic well-being as per capita income, diversification of industry and agriculture, and stability of employment did not figure in decisive ways. These entered the discussion of the wisdom of the projects more as rationalizations than as prior justifications.

A similar chronology occurred with the construction of Grand Coulee Dam on the Columbia River in Washington by the Bureau of Reclamation. Grand Coulee was part of a basin-wide scheme in the sense that it had been selected by the Bureau of Reclamation as a major element in a program for water development in the Columbia; but it was not a part, strictly speaking, because it was authorized long before substantial agreement had been reached among the Bureau of Reclamation, the Corps of Engineers, the Fish and Wildlife Service, and the various state interests as to the full outline of such a program.[54] Once underway, however, its full effects became a subject of lively speculation, leading the Bureau of Reclamation, with the leadership of Harlan Barrows, to initiate the "Columbia basin joint investigations." The scope of those studies is suggested by the participants, including nineteen federal agencies, eleven state agencies, and thirteen local and private institutions, and by the twenty-eight problems set for investigation.[55] Those problems covered questions of farm economy, farm size and layout, control of land use, village and community centers, transport facilities, recreational needs, and public works programming and financing.

Expected answers to such questions have figured repeatedly in the justifications given before public groups for Grand Coulee and also in descriptions given of results expected from many other basin programs modeled, in part, upon the TVA experience. Thus, the arguments made in favor of the Damodar Valley Authority in India have carried statements that:[56]

> The Corporation is to execute and operate schemes for irrigation, the generation of power and flood control. Besides those three main purposes, the Corporation will promote navigation, afforestation, public health, and industrial, economic and the general well-being of the people of the Valley.

[53] GORDON R. CLAPP, THE TVA: AN APPROACH TO THE DEVELOPMENT OF A REGION 54-56, 65 (1955).

[54] See CHARLES MCKINLEY, UNCLE SAM IN THE PACIFIC NORTHWEST 138-45 (1952).

[55] U. S. BUREAU OF RECLAMATION, DEP'T OF INTERIOR, COLUMBIA BASIN JOINT INVESTIGATIONS: CHARACTER AND SCOPE (1941).

[56] ECONOMIC COMM'N FOR ASIA AND THE FAR EAST, *op. cit. supra* note 3, at 78.

The distinction which seems crucial here is between engineering works which are planned and carried out with the sole purpose of gaining the direct benefits, such as power production or flood damage reduction from the water regulation, and engineering works which are intended to promote basic changes in the quality of life of the residents of the region. Under the second view, two considerations enter which are ignored under the first. The direct benefits become a means to an end, rather than an end in themselves; and engineering becomes one of several possible instruments, including land use, which may serve the needs of regional change. In the Miami Conservancy District plan, there was earnest desire to prevent future flood losses and to stabilize the then prevailing economy, but no concern to effect any significant changes in the distribution or character of urban occupancy in the basin: the aims stopped with the achievement of flood control. As the TVA unfolded, however, the control of floods was seen as a method of advancing a new economic and social well-being of residents of the Tennessee Valley, and power and navigation were viewed similarly. The moment in an analysis of a river basin development opportunity that this first distinction is made and that the construction of physical works takes on larger implications, the second distinction arises. If engineering is a means toward an end, then other means deserve attention as possibly contributing to or alternately serving the same end.[57]

Under the broadened view, the Bureau of Reclamation becomes as much concerned with the maintenance of family-sized farms as with optimum dimensions for distribution canals; and the Tennessee Valley Authority, from the beginning of its power program, lays stress on the marketing practices of farmers' electricity cooperatives as well as on the integration of hydroelectric and thermal-electric generating stations in the maximization of firm power production. Land use improvement, the economics of potential mineral exploitation, and the relation of freight rates to traffic movement and manufacturing location, are among the lines of inquiry that vie in importance with standard hydrologic and civil engineering practices in the planning of the river basin development.

It may appear that to take this broader view of river basin development is to expand water resources planning to encompass all aspects of natural resources as related to economic growth, including the cultural conditions of the society, and it will be necessary to ask whether or not there is any viable line which may be drawn between one and the other. For if there is no viable line, the attempts to carry water resources analysis beyond the traditional concepts of multiple-purpose, basin-wide development must inevitably lead to comprehensive regional development schemes in which water, in many instances, would play a secondary role.

Without attempting to answer that question, it may be useful to observe that no clear pattern of associated regional activities has yet emerged from the experimentation that currently is in progress in river basin development. It is not even possible

[57] A succinct statement of the idea of comprehensive regional development, as it took shape in the 1930's and 1940's, is ALVIN H. HANSEN & HARVEY S. PERLOFF, REGIONAL RESOURCE DEVELOPMENT (1942).

to find association of electricity distribution and electricity production activities where hydroelectric plants are in operation. For example, the Compagnie National du Rhône avoids any connection with marketing policies for the power which it sells in bloc to Electricité de France.[58] In general, the basins having more nearly unified administrative control of their water-regulation works have a larger number of associated activities directed at steering regional growth.

There is little clarity as to whether the aim of such growth should be specialization or balance, and the indices of results are scattered and rudimentary at best. Measures of aggregate economic growth are handicapped by lack of data, as well as by incompleteness of the theory of the process of growth. Less tangible noneconomic growth is even more difficult to quantify. There have been earnest efforts to improve the measurement devices, but these are still far from keeping pace with the claims of project proponents.[59] The claims for "secondary benefits" from investment in irrigation facilities continue to be in controversy among federal agencies.[60]

In its lack of definition and in difficulty of gauging the results of its use, the idea of comprehensive regional development has less precision and form than either multiple-purpose storage or basin-wide plan.

III

ASSOCIATED IDEAS

In addition to the three ideas described above, two others have enjoyed some popularity and individually have found expression in one or more development programs. They are less widely applied than the three already described and less firmly grounded in either theory or demonstrated practice, although they have attracted, in some instances, greater attention. One is the concept of articulated land and water programs; the second, the concept of unified administration. The former has commanded adherence over long periods and receives lip service generally today, but is honored 1933 and has been kept alive by controversy and opposition rather than by acceptance. more in theory than in practice. The latter bloomed suddenly and vigorously after

A. Land and Water

Early in the histories of scientific agriculture and river engineering, the idea took shape that the management of land and its vegetative cover is closely linked with the proper management of the flow of water in streams, that the magnitude, variation, and quality of water moving in a drainage basin is, in some measure, influenced by

[58] See TOURNIER, *op. cit. supra* note 47, at 304-05.

[59] Problems of economic indices are outlined in Krutilla, *Criteria for Evaluating Regional Development Programs*, 45 AM. ECON. REV. 120 (1955). Moore, *Regional Economic Reaction Paths*, *id.* at 133; and the discussion that follows. *Id.* at 149.

[60] FEDERAL INTER-AGENCY RIVER BASIN COMMITTEE, PROPOSED PRACTICES FOR ECONOMIC ANALYSIS OF RIVER BASIN PROJECTS (1950). See also TECHNICAL ASSISTANCE ADMINISTRATION, FORMULATION AND ECONOMIC APPRAISAL OF DEVELOPMENT PROJECTS (U.N. Pub. Sales No. 1951.II.B.4.); and U. S. BUREAU OF RECLAMATION, DEP'T OF INTERIOR, REPORT OF PANEL OF CONSULTANTS ON SECONDARY OR INDIRECT BENEFITS OF WATER-USE PROJECTS (1952).

the treatment of the land. Although the origins of this idea are not clear,[61] it does seem to have been widely held in western Europe by the beginning of the nineteenth century. Summing up much of the study in the middle decades, Marsh found a weight of evidence that forests affect the rise and fall of springs and normal volume of rivers and the character of floods in rivers and torrents.[62] French engineers and foresters long had been concerned with relationships between their two lines of action, principal attention being given to the restoration of denuded sections of the High Alps. Agitation for regulation of forest and grazing practices as a means to controlling mountain torrents were suggested by administrative officers in 1819, and the first timid national legislation was passed in 1859, with major legislation following in 1882.[63]

Action was much slower in the United States, where problems of denudation were then considered less acute. For example, Gilbert, on the basis of reconnaissance studies in Utah, was not concerned with threats of accelerated erosion and concluded that if man did have an effect upon stream flow in the Rocky Mountain region, it probably would be advantageous by increasing the supply.[64] In the 1890's, however, some of the foresters began agitation for federal acquisition of forested lands in the drainage areas of important streams and for the retention of federal control over such lands where they had not passed to private ownership.[65] This culminated in the Weeks Law of 1911, which established federal acquisition of such forested, cutover, or denuded lands as "may be necessary to the regulation of the flow of navigable streams."[66] The forest program was expanded in 1924 to deal more explicitly with production problems, and there was a flurry of interest in forests as a preventive for floods following the 1927 disaster.

Then, three events placed agricultural workers directly in the river basin development field. The establishment of the Soil Conservation Service,[67] under Hugh Bennett, led to vigorous studies of channel and reservoir silting, to the establishment of experimental watersheds, and to the study of erosion conditions and corrective measures on a drainage basis. In 1936, the Flood Control Act, which shouldered federal responsibility for flood damage reduction on a national basis, authorized the Secretary of Agriculture to make surveys of "measures for runoff and water flow retardation and soil erosion prevention."[68] The TVA Act also permitted the establish-

[61] No attempt is here made to trace the earlier evolution of this idea. It occurs in much Greek, Hebrew, and Roman literature. For a brief review of evolving views of the unity of nature, see Glacken, *The Origins of the Conservation Philosophy*, 11 J. SOIL & WATER CONSERVATION 63 (1956).

[62] GEORGE PERKINS MARSH, THE EARTH AS MODIFIED BY HUMAN ACTION 225, 227 (1885). Marsh did not feel warranted in asserting, however, that forests, by their presence or absence, increase or lessen the total volume of water discharged by rivers or torrents.

[63] See M. P. MOUGIN, LA RESTAURATION DES ALPES 145-60 (1931).

[64] Gilbert, *Water Supply*, in POWELL, *op. cit. supra* note 34, at 57. Interest then centered on prospects for climatic fluctuations.

[65] See GIFFORD PINCHOT, BREAKING NEW GROUND 238-40 (1947).

[66] Act of March 1, 1911, 36 STAT. 961, as amended, 16 U.S.C. §§515-16 (1952).

[67] Act of June 16, 1933, 48 STAT. 195, and Act of April 27, 1935, 49 STAT. 163, 16 U.S.C. §590 (1952).

[68] 49 STAT. 1570 (1936), 33 U.S.C. §701(a) (1952). This was extended by Act of Aug. 28, 1937, to cover all drainage areas previously authorized for survey by the Corps. 50 STAT. 877, 33 U.S.C. §701(g) (1952).

ment of divisions of forestry and agricultural relations. Out of these surveys by agricultural experts, there came a series of reports recommending appropriate measures for land-use treatment in selected drainage areas. These were the subject of extensive and often controversial review by the Corps of Engineers and Bureau of Reclamation. Eleven of the basin plans were completed, others delayed, and, with interruptions caused by war conditions and by problems of administrative jurisdiction within the Department, the program slowed down until the Department of Agriculture's interest in river programs was sharply revived by enactment, in 1954, of a new watershed-protection and flood-prevention program, under which direct action could be taken more readily by departmental agencies in cooperation with the land owners.[69]

A notable feature of the evolution of action by the land-management agencies is that, with a few exceptions, the work recommended on the land was not of such a character or degree of reliability in its effects upon water flow as to warrant making any changes in engineering works proposed for the same drainage areas. That is, flood-control reservoirs were not rendered needless by the prospect of stopping flow upstream, and storage reservoirs were not obviated by retention of water through forest or cropping practices. Such a conclusion was strongly at variance with the beliefs of many advocates of land management as an alternative to engineering and provoked a series of running debates which, in later years, centered successively upon the work of the President's Water Flow Committee, the Trinity River study, and the cooperative investigation of the Washita Basin.[70]

While this is not the place to enter into the jousting over land management versus engineering in river basin development, it may be useful to offer a few observations on the problem by way of partial explanation for some of the difficulties. The idea that land management may have an important effect upon water flow has received wide publicity in the United States in a series of reports over half a century.[71] It has not been translated into action in more than a few instances, because the responsible engineers have been either unable or unwilling to recognize direct and reliable connections with their programs.[72] One difficulty has been that proponents

[69] Act of Aug. 4, 1954, 68 STAT. 666, 16 U.S.C.A. §§1001-06b (Supp. 1956).

[70] See President's Committee on Water Flow, *Report*, H. R. Doc. No. 395, 73d Cong., 2d Sess. (1934).

[71] Some of the notable statements are: W. W. Ashe, *Special Relations of Forests to Rivers in the United States*, S. Doc. No. 325, 60th Cong., 1st Sess. 514-34 (1908); U. S. Dep't of Agriculture, *A National Plan for American Forestry*, S. Doc. No. 12, 73d Cong., 1st Sess. 299-461, 1509-36 (1933). UPSTREAM ENGINEERING CONFERENCE, HEADWATERS CONTROL AND USE: A SUMMARY OF FUNDAMENTAL PRINCIPLES AND THEIR APPLICATION IN THE CONSERVATION AND UTILIZATION OF WATERS AND SOILS THROUGHOUT HEADWATER AREAS (1937).

[72] Thus, the ASCE Special Committee reported in 1916: "The effects of forest growth in preventing erosion on hillsides are sufficient to justify reforestation for that purpose, but there has been no quantitative determination of its influence on stream flow which would justify its employment as a method of flood prevention." *Hearings, supra* note 23, at 298.

An example of the contrary view is: "The forest tends to equalize the flow throughout the year by making the low stages higher and the high stages lower.

"Floods which are produced by exceptional meteorological conditions cannot be prevented by forests, but without their mitigating influence the floods are more severe and destructive." Raphael Zon, "Forests and Waters in the Light of Scientific Investigation," in National Waterways Comm'n, *Final Report*, S. Doc. No. 469, 62d Cong., 2d Sess. app. V, at 205, 273 (1912).

A more reconciling view is this: "Forest rehabilitation is not urged as an alternative to engineering

of each view have tended to exaggerate their own claims and to minimize those of others, so that foresters have at times claimed that reforestation would reduce the greatest Ohio floods, and engineers have maintained that soil erosion control had no part whatsoever in the sediment movement of streams.

The lack of scientific knowledge on which to settle disputes of that character has prevented clear answers and has permitted the controversies to continue inconclusively. Much information still is lacking. For example, the mechanism by which sediment finds its way into small watercourses is understood imperfectly, and the effect of land management upon ground-water flow is uncertain in many areas. It is only in recent years that it has been practicable for scientists to suggest valid generalizations as to the relationship between timber cutting and water yield or as to the possible effects of terracing upon flood flows.[73]

Thoroughly articulated programs of land and water development in the same basin, then, must be regarded as more hope than reality. They often have been joined in statements, but rarely in action.

B. Unified Administration

Following the enactment of the TVA Act, proposals for the creation of similar government agencies followed thick and fast for other basins. The distinguishing and common idea was the creation of an administration having full authority for dealing with whatever were the water and associated resource problems in the basin involved. Prior to that time, water projects characteristically were handled by the agency responsible for the major purpose. This might be a conservancy district for a flood-control problem, a city engineer department for a municipal water supply, an irrigation district and the Bureau of Reclamation for irrigation, a city or a drainage district and the Corps of Engineers for flood control. The Ruhr probably had the most complex administrative organization for its control works, involving several cities, two regional groups, and three drainage-area agencies. Now, the thinking turned to a single agency.

In the United States, proposals ranged from a general plan for subdividing the United States into valley authorities[74] to individual agencies for the Columbia, the Missouri, and the Arkansas. None received congressional approval, although it may be argued that some had large nuisance value in forcing livelier activity and cooperation among federal agencies where the independent agency threatened.[75] Indeed, the

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works for flood control. It is supplementary to the engineering program, but it is a supplement of such importance that no complete plan of flood control can omit it." Sherman, "Protection Forests of the Mississippi River Watershed and Their Part in Flood Prevention," in U. S. Dep't of Agriculture, *Relation of Forestry to the Control of Floods in the Mississippi River*, H.R. Doc. No. 573, 70th Cong., 2d Sess. 51 (1929).

[73] See Wilm, *Timber Cutting and Water Yields*, in YEARBOOK OF AGRICULTURE 593 (1949); LUNA LEOPOLD AND THOMAS MADDOCK, THE FLOOD CONTROL CONTROVERSY (1955).

[74] See McKinley, *The Valley Authority and Its Alternatives*, 44 AM. POL. SCI. REV. 607 (1950).

[75] It also may be argued that the results of these forced unions were more legitimate than in the public interest. See Hart, *Governing the Missouri*, 41 IOWA L. REV. 198 (1956).

number of federal and state agencies involved in water resource development has tended to increase.[76]

Outside of the United States, the pattern of unified administration has been adopted sparsely. The Compagnie National du Rhône enjoys much the same quality of independence of regular government agencies, functioning as a joint stock company.[77] In the United Kingdom, a system of catchment basin authorities was established in 1930 to unify efforts to deal with land drainage, pollution abatement, flood control, and associated problems.[78] These have been established in forty-six areas and function independently of the Central Electricity Board. When the North of Scotland Hydro-electric Board was set up in 1943, however, its functions were limited to power production.[79]

Other agencies having unified control over the waters of entire basins include the Carini Valley Authority in Venezuela, the Caucas Valley Corporation in Colombia, the Damodar Valley Authority in India, the Snowy Mountains Hydroelectric Authority in Australia, and the Helman Valley Authority in Afghanistan. Each has variations from the TVA pattern. From the information available, however, all include an agency with powers to design, construct, and operate water-control works and to conduct associated activities, although they differ considerably in other respects. There has been no careful review of their functioning to date. It would appear that the idea of unified administration has spread from the Ruhrverband, TVA, and the English catchment basin experience to a few other areas, but is not, thus far, closely linked with large-scale river basin development.

IV

INTERNATIONAL AND INTERSTATE APPLICATIONS OF THE CONCEPT

Efforts to deal with basins and regions as units have raised major problems of scale and of political organization. These are suggested in part by the location of basins with respect to political boundaries. Complexities of administrative jurisdiction clearly have played a role in the retardation of some river basin development programs but also have contributed to decisive action in others.

It will be observed from Figure 1 that a large proportion of the major drainage basins of West Europe, Africa, Southeast Asia, and South America are international in character. In the United States, the Soviet Union, and China, the opposite is true, although each has one or more major streams having international drainage. If basin-wide plans be taken as ultimately desirable, then it is clear that the Columbia, Colorado, St. Lawrence, Rio Grande, Orinoco, Amazon, Parana, Uraguay, Rhine,

[76] See White, *National Executive Organization for Water Resources*, 44 AM. POL. SCI. REV. 593 (1950).

[77] See GILBERT TOURNIER, L'AMENAGEMENT DU RHÔNE (1953).

[78] Under the Land Drainage Act of 1930, 20 & 21 GEO. 5, c. 44, catchment boards were established in England and Wales. They are composed of representatives of central and local government agencies concerned.

[79] See MacColl, *Hydro-electric Developments in the Scottish Highlands*, in 4 TRANS. FOURTH POWER CONFERENCE 2158 (1950).

Rhône, Danube, Tagus, Nile, Tigris-Euphrates, Congo, Niger, Zambesi, Indus, Ganges-Brahmaputra, Mekong, and Amur require international collaboration for their wise planning. Lesser streams could be mentioned, but this suggests the magnitude of the problem. Only the Mississippi, Don, Dneiper, Volga, Ob, Yenisey, Lena, Yangste, and Yellow, among the great rivers, are free from the complication of crossing man-made borders.[80]

Within individual countries, the difficulties do not stop. The complexity of political administration imposed by state boundaries is apparent in the United States where, as shown in Figure 2, more than three-quarters of the land area is drained by streams crossing one or more state boundaries. The proportion would be even larger if the streams draining into the Great Lakes were counted as interstate, since, strictly speaking, all of them drain into interstate lake waters and through the St. Lawrence River. They are treated on the map as intrastate units, however, although one major diversion is made down the Illinois River and although the Great Lakes states have, during 1956, organized to begin the planning of work, such as port development, on an interstate basis. The major basins which are intrastate are the Central Valley of California, the Brazos, Colorado, and Trinity in Texas, and the Altamaha, Cape Fear, and James along the eastern seaboard.

Forty per cent of the area of the United States is drained by the Mississippi, a stream so great and complex that its planning has been largely in terms of subbasins. Even when subdivided, the interstate basins loom large, leaving only a few major streams such as the Wisconsin, Kaskaskia, Green, Miami, Scioto, Muskingum, and Yazoo lying wholly within one state. The picture for the western tributaries of the Mississippi is complicated further by the present or proposed transmountain diversions from the Colorado basin. In view of the large diversion from the lower Colorado to the Los Angeles basin, full consideration of basin water strategy in the western Mississippi basin would require attention to Colorado and Southern California needs, and those now are linked with the Columbia in tentative schemes for later diversions.

Looking back over the growth of the basin-wide idea in the United States, it is notable that the earlier examples of action were intrastate—the Miami, Muskingum, Wisconsin, and Central Valley of California. On the other hand, the large and dramatic examples of both multiple-purpose and basin-wide planning came in interstate situations, where strong leadership and participation by the federal government was necessary to organization and financing.

The discussion, thus far, has dealt chiefly with the evolution and demonstration of individual ideas comprising the concept of integrated river basin development. Some of the demonstrations were not associated with other parts of the concept: thus, the Miami was strictly single-purpose; and Hoover Dam, while multiple-purpose, was not, in its first years, linked with a comprehensive basin plan. The degree to which the complete concept has been translated into action is revealed, in

[80] And even the Mississippi is not entirely free from international complications. A tributary of the Missouri, the Milk River, drains both Canadian and United States territory and is the subject of an international agreement.

part, by Table 1 and Figure 3. These show some major river basin development schemes constructed or under construction, as of 1957. Where a basin-wide plan has been projected but work is presently limited to only one project, as in the case of the Zambesi and the Volta, the entire area is shown. Where one project has been constructed without being linked with a basin plan, it is omitted. The Niger Office, responsible for the inland delta, is a borderline case. Systems of single-purpose projects also are omitted.

TABLE I—REPRESENTATIVE INTEGRATED RIVER BASIN DEVELOPMENT PROGRAMS

Basin	Area (Sq. Mi.)	Major purposes A Fertilizer manufacture F Flood control I Irrigation M Manufacturing N Navigation P Electric power S Soil conservation T Forestry	Brief description of works (Dams are storage unless otherwise designated. Installed hydroelectric capacity is shown in kilowatts.)
Columbia (United States)	partial 219,500	F-I-N-P	16 dams (4,500,000 KW). 41 nonfederal hydroelectic plants. Irrigation diversion dams and canals. At least 15 other dams planned. Navigation works.
Damodar (India)	8,500	A-F-I-M-N-P-S-T	7 dams underway (200,000 KW). Navigation channel. Land treatment. Industrial plant.
Huai (China)	67,200	F-I-N-P	15 detention dams. 7 storage dams. Levees and drainage works. Irrigation works. Locks. 2 hydroelectric plants (35,000 KW).
Kitakami (Japan)	3,950	F-I-P	7 dams (172,000 KW). Irrigation works.
Oum er Rbia (Morocco)	13,500	I-P	6 dams and hydroelectric plants (158,000 KW). Irrigation works and improvement. Diversion dams.
Rhône (France)	partial	I-N-P	2 dams and one other hydroelectric plant (700,000 KW). Locks and canals. 11 other dams and hydroelectric plants planned.

Tennessee United States	40,670	F-N-P-A-S-T	27 dams (2,600,000 KW). Locks. Fertilizer plant. Fuel electric plants. Agricultural demonstration.
Tigris-Euphrates (Iraq)	partial 192,193	F-I-P-N	4 dams (700,000 KW). 7 diversion dams. 7 others planned. Land drainage and irrigation. Locks.
Volga-Don (U.S.S.R.)	695,700	I-N-P	3 major dams (3,860,000 KW). Locks. Navigation canals. 3 other hydroelectric plants. 2 others planned. Irrigation works.

It is apparent from Figure 3 that the chief areas in which systems of multiple-purpose projects are under way lie either wholly within one country or are restricted to that part of the drainage located within one country. In terms of size of drainage area, the larger areas are located in Brazil (the San Francisco), China (the Huai and Yellow), India (the Damodar and Mahanadi), the Soviet Union (the Amu-Darya, Dneiper, Don, and Volga), and the United States (the Central Valley of California, Arkansas-White-Red, Columbia, Colorado, Missouri, Rio Grande, Savannah, St. Lawrence, Tennessee, and upper Ohio). Smaller complete drainages or subbasins include the Snowy Mountains—Murray scheme in Australia, the Ruhr-Emscher-Lippe in Germany, the Kitakami in Japan, the Papaloapan in Mexico, the Oum er Rbia in Morocco, and lesser streams in Puerto Rico and the Philippines.

The international streams which are being developed within only one country are the Rhône in France, the Zambesi in the Central African Federation, the Volta in the Gold Coast, and the Tigris-Euphrates in Iraq. No major international stream is receiving completely integrated treatment across frontiers. Perhaps the nearest approaches are on the Columbia River, through the International Joint Commission, and on the Rio Grande, through the International Boundary Commission. Parts of the Indus system are receiving attention on both sides of the India-Pakistan border, without agreement as to the precise terms of regulation and use, and there is a loose agreement affecting Nile waters.

In mapping the more important schemes, two criteria were used: they must involve systems of multiple-purpose projects, and they must involve the entire drainage basin or subbasin within the country of operations.

V

ASPIRATIONS AND STIRRINGS

Spread of the essential ideas in unified river basin development has been outlined in terms of action taken across the continents. It might also be perceived, though less precisely, in the aspirations which reflect themselves in citizen, national, and international plans commanding public attention, but not yet channeled into con-

struction works. These would include some basins, such as the Connecticut, where plans have been made, but in which unified action has not yet been launched, and other basins where discussion is far ahead of any detailed planning, as in the upper Amazon basin.

The Nile basin is still in the preliminary stage: notwithstanding the waters agreement, plans for the Aswan High Dam do not take account of possible future needs and regulatory action in the Sudan, Ethiopia, and Tanganyika sections of the basin. Likewise, the Jordan River has been studied repeatedly, without arriving at a satisfactory agreement. The Rhine River, though the subject of Dutch-German and German-French-Swiss negotiations, has not been subjected to a single, unified plan.[81] Both official and citizens groups now are working to perfect more precise arrangements for handling the Rhine waters in flood and drought. Danubian cooperation embraces only a portion of that basin. Congo planning for integrated land and water transportation facilities is well advanced without comprising a system of water regulatory works for other purposes. There are large new storage projects in the upper Ganges and river channel improvement plans for the Mekong that may, in time, evolve into unified systems of projects. An agreement concerning the Amur has been negotiated during the past year.

VI

SIGNIFICANCE OF THE CONCEPT IN PRACTICE

Reviewing the evolving ideas of the past sixty years as they now find expression in landscape and livelihood and aspiration, a few aspects stand out:

The idea of multiple-purpose water storage, while once considered of doubtful practical value, now is firmly established in present construction technology.

The idea of unified basin plans has moved slowly from theoretical acceptance to practical application: in the United States, first slowly in intrastate drainages, then quickly in the more challenging interstate drainages, but, thus far, across no international boundary to cover a complete basin.

The idea of comprehensive regional development has gained gradually in application, the vague vision of regional growth being more persistent than efforts to define or measure it.

Associated with the second of these ideas, the idea of land improvement integrated with water use and control has remained in popularity, but has been applied only rarely in genuine plans and programs.

Spreading rapidly in the realm of public discussion, the idea of unified administration has skipped from the TVA and the Rhône to a few other places, but has inspired more controversy than imitation.

Throughout the period, there has been conspicuous lack of careful appraisal of the work accomplished. A tool capturing imaginative support, as this one does,

[81] See, Wehle, *International Administration of European Inland Waterways*, 40 AM. J. INT'L L. 100 (1946).

deserves penetrating assessment, and such examination has been largely absent. For every hundred studies of what might or should be done with a river system, there is hardly one that deals with the results. In so far as the results are physical, some may be measured readily—kilowatts of power produced, cubic feet of water delivered, inches of reduction in peak flow, acres irrigated. Some physical results have been touched only lightly, as, for example, effects of water storage and mixing on downstream erosion and water quality.

The social results are perceived dimly; there are only the roughest gauges of the effects of river works upon economic growth and community stability or change. Little basis exists for comparing the effectiveness of one multiple-purpose plan with another for the same basin or with an alternate method of fostering social change. Thus far, there has been no genuinely searching assessment of the full impact of the TVA operations, and it is needed.[82] Yet, if it were to be undertaken, it would require as a first step a sharpening of devices for measuring construction efficiency, economic growth, and cultural advancement. Strict adherence to the ideas of multiple-use regulation for entire basins leads inevitably to confrontation of regional aims and social processes.

[82] McKinley, *TVA Management in the Perspective of Two Decades*, 16 PUB. ADMIN. REV. 109 (1955); Fisher, *Resource Problems and the Social Sciences*, in RESOURCES FOR THE FUTURE, ANN. REP. 15 (1956).

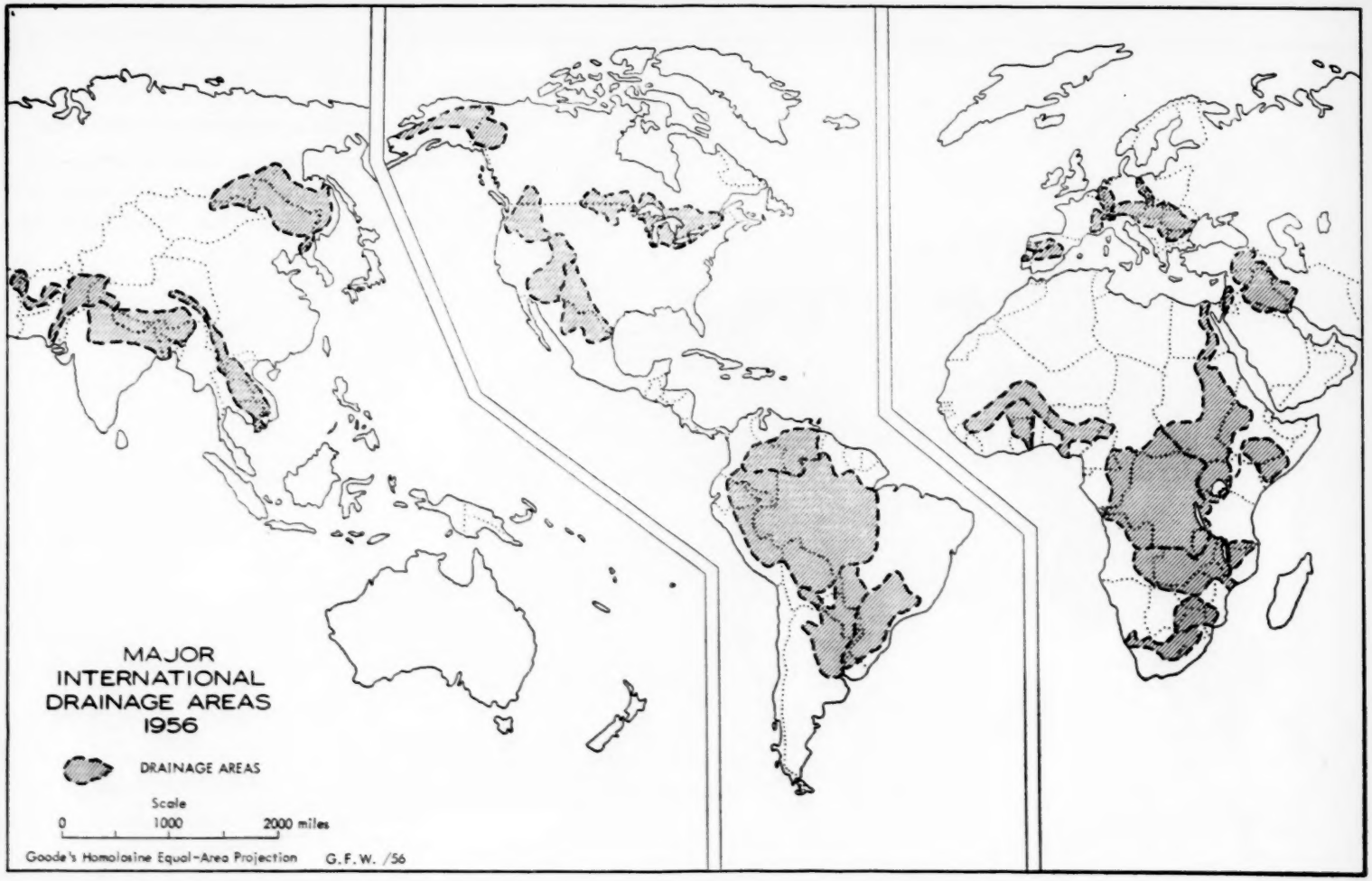
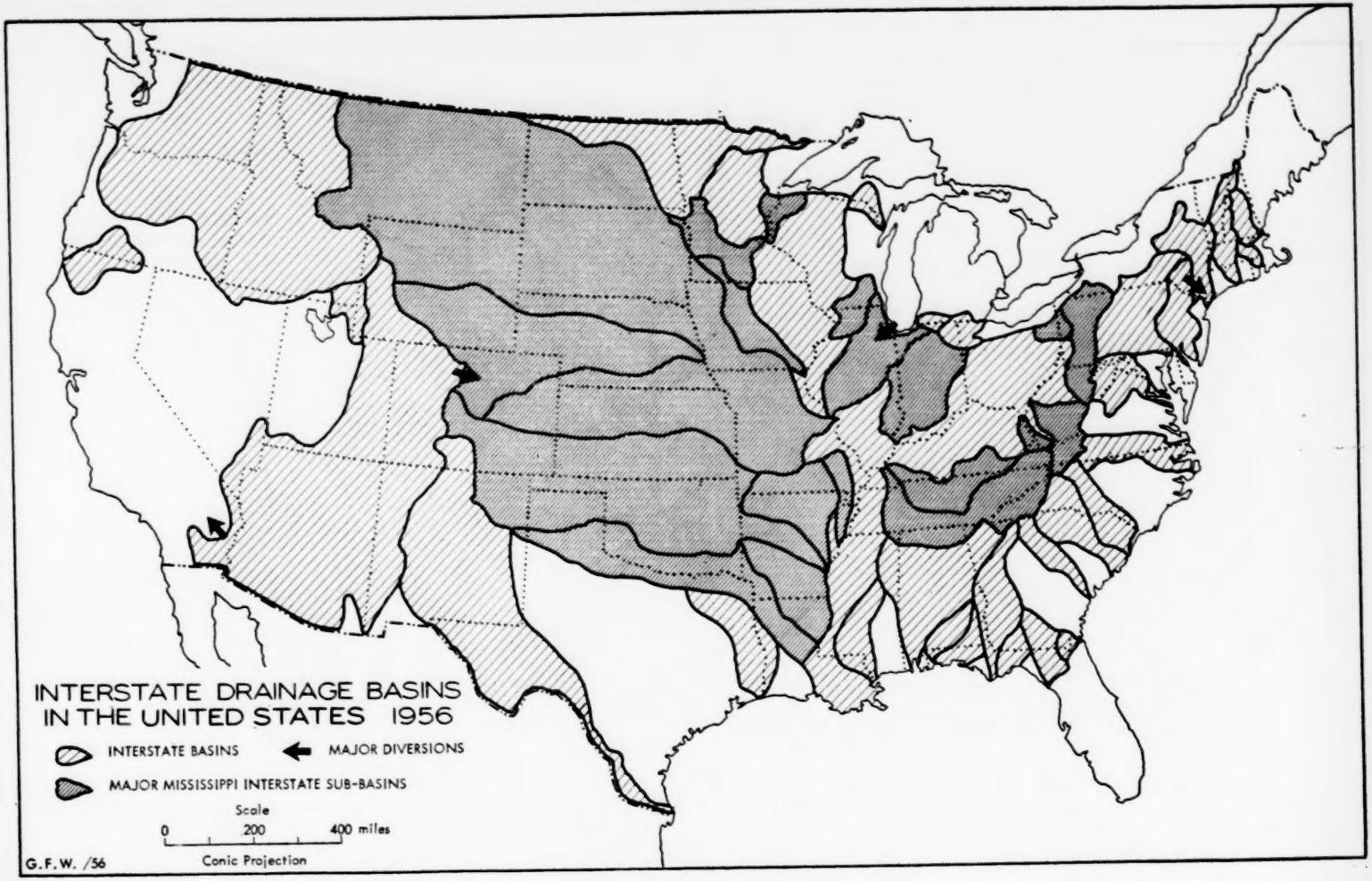

MAJOR
INTERNATIONAL
DRAINAGE AREAS
1956
DRAINAGE AREAS
Scale
0
1000
2000 miles
Goode's Homolosine Equal-Area Projection
G.F.W. /56

FIGURE 1


INTERSTATE DRAINAGE BASINS
IN THE UNITED STATES 1956
INTERSTATE BASINS
MAJOR DIVERSIONS
MAJOR MISSISSIPPI INTERSTATE SUB-BASINS
Scale
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200
400 miles
G.F.W. /56
Conic Projection

FIGURE 2

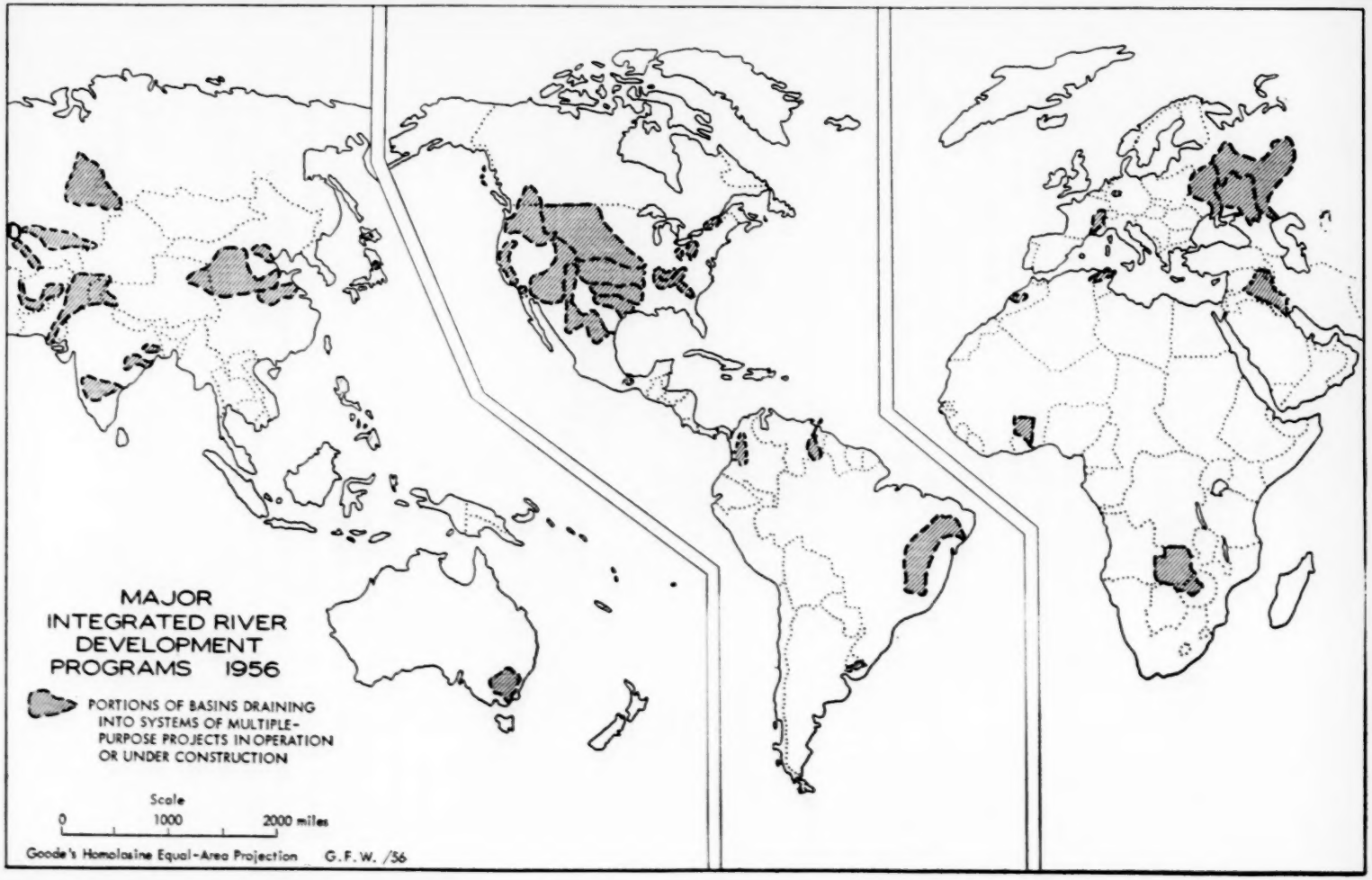
MAJOR
INTEGRATED RIVER
DEVELOPMENT
PROGRAMS 1956
PORTIONS OF BASINS DRAINING INTO SYSTEMS OF MULTIPLE-PURPOSE PROJECTS IN OPERATION OR UNDER CONSTRUCTION
Scale
0
1000
2000 miles
Goode's Homolosine Equal-Area Projection G.F.W. /56

FIGURE 3

SOME ENGINEERING ASPECTS OF RIVER BASIN DEVELOPMENT

ARNO T. LENZ*

Engineers are concerned with river basin development in two ways: First, they and their associates in meteorology, geology, and soil science are responsible for the collection of the physical data which tell how much water there is in the basin under consideration and how that water is distributed. Secondly, when these facts are known or can be estimated with reasonable accuracy, engineers must plan, design, build, and operate structures to control the water for the benefit of man. This article will briefly explore the nature and scope of these engineering roles.

I

HYDROLOGY

A. The Hydrologic Cycle

The central concept of hydrology is the hydrologic cycle. This describes the circulation of water from its vapor form in the atmosphere, through precipitation, largely as rain or snow, its disposition by infiltration into the ground or by surface runoff into rivers, its storage in lakes and seas, and its eventual return, through evaporation and transpiration, to the atmosphere. The cycle is exceedingly complex and variable. There are short-cuts and delays: some raindrops are evaporated as they fall and complete the cycle in a few moments; other water molecules lie for ages in dead storage as glacial ice or in the deep seas. The cycle continues perpetually because heat energy from the sun, through evaporation and transpiration, lifts water to the atmosphere, and gravity pulls it back down to earth, over the earth's surface and within the geologic strata.

B. Basic Data

The water available for river flow is primarily dependent on precipitation. This varies greatly, geographically and with respect to time, seasonally as well as over longer periods. There are cycles in precipitation, but they are so complex as to be of little value for predicting the future. Looking backward at what has happened at a particular location during a specific period is somewhat more rewarding. The most regular variation is the seasonal one which occurs within each year, but even here, precipitation during extremely wet or dry periods fluctuates widely from the average value.

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Precipitation is measured and studied by meteorologists, climatologists, and hydrologists. In the United States, it is the responsibility of the Weather Bureau, United States Department of Commerce, to record precipitation data and publish them. Daily precipitation amounts and the monthly totals are published in *Climatological Data* for hundreds of gages all over the United States and its territories. Generally, publication is by states and for calendar months. The thirteenth publication each year is an annual summary which contains monthly totals for each gage and also the annual total for the calendar year. Rainfall amounts for individual hours are published in *Hourly Precipitation Data* for selected stations which have recording gages. These data are necessary when studying rainfall of high intensity for short duration.

Various other governmental agencies at the federal and sometimes the local level also collect records. Power companies, irrigation districts, and some individual farmers and ranchers may also have records of value. Many of these, however, are collected in cooperation with the Weather Bureau and published in the regular manner.

Rain which falls on the ground either infiltrates into the soil or runs off into the streams and lakes. Initial infiltration is usually at a higher rate than the average, especially after long dry spells. These rates are greatly influenced by the type and condition of surface soil and sometimes by the subsoil, particularly when the surface soil is thin. Surface detention by contour furrows and dense vegetal cover, such as heavy grass growths and forest leaf mould, all retard surface runoff, at least temporarily, and tend to increase infiltration, other things being equal. The slope of the ground surface is also an important factor in determining the speed of runoff and, therefore, the opportunity for infiltration.

Surface runoff into the streams, lakes, and rivers is the residue from rainfall after the infiltration capacity of the soil has been satisfied. The surface runoff is added to the base flow of the streams, and the total runs off the land into the seas if it is not evaporated along the way. The base flow comes from the ground water, which is replenished by infiltration. During dry periods, the rate of ground-water flow into the streams decreases, and there is gradual recession of the base flow. In semiarid regions, where there is little ground water, the streams dry up completely between rains.

In northern regions and at high altitudes, winter precipitation is largely in the form of snow, which may be stored for several months before it runs off in the spring and early summer. Snow surveys are made in the western mountains and a few other places to determine the water content of the snow pack. Thus, in streams fed by extensive fields of melting snow, it is possible to determine, with a relatively high degree of accuracy, the relation of each year's snowmelt runoff to the mean for several years and to estimate its effect on water supplies.

In the United States, it is the responsibility of the Geological Survey, United States Department of the Interior, to measure streamflow and publish these data in

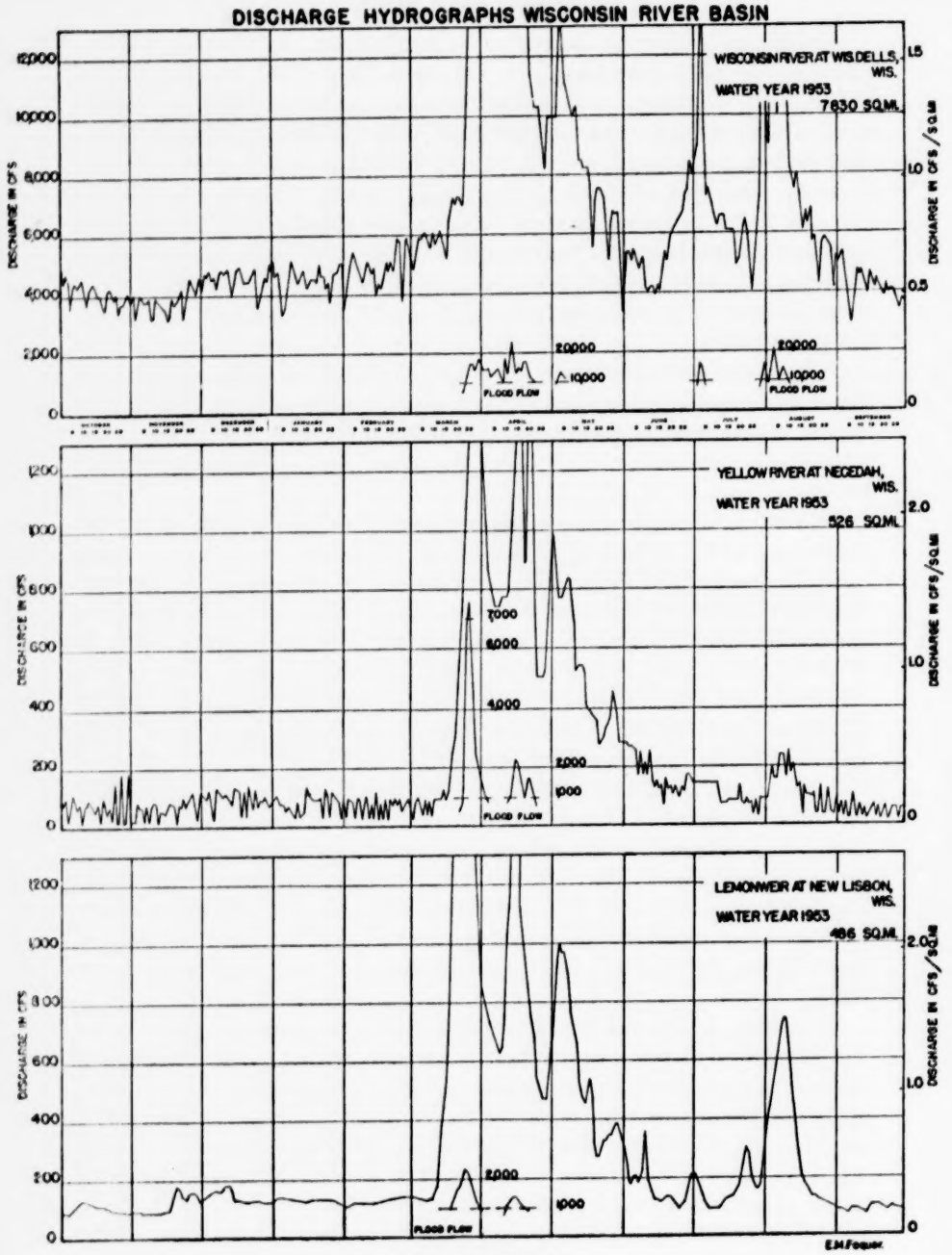
DISCHARGE HYDROGRAPHS WISCONSIN RIVER BASIN
WISCONSIN RIVER AT WIS DELLS, WIS.
WATER YEAR 1953
7630 SQ.MI.
DISCHARGE IN C.F.S.
DISCHARGE IN CFS/SQ.MI
FLOOD FLOW
YELLOW RIVER AT NECEDAH, WIS.
WATER YEAR 1953
526 SQ.MI.
LEMONWEIR AT NEW LISBON, WIS.
WATER YEAR 1953
486 SQ.MI.
E.M. Foster

FIGURE 1

Geological Survey Water-Supply Papers. The records are collected for fourteen river basins, some of which are further divided into parts *A, B,* etc. For each gage, the average daily flow in cubic feet per second is given for each day of a "Water Year," beginning October 1 of a year and ending on the next succeeding September 30. The 1956 Water Year, for example, is defined as that ending September 30, 1956. The *Water-Supply Papers* contain data as to the gage location; the drainage area in square miles which contributes water to the river at the measuring point; gage description; the average and extremes of discharge for the entire record, for the year, and for each month, and remarks regarding the quality of record; and upstream regulation and diversion.

It should be noted that the "years" used by the Weather Bureau and Geological Survey do not embrace the same twelve-month period. It is a simple matter, of course, however, to compute the average precipitation for a "water year" or the average streamflow for a "calendar year," if necessary.

C. Streamflow Analysis

Streamflow data can best be visualized by plotting daily flows in chronological order for a year in a curve known as a "discharge hydrograph" (some examples of which are set forth in Figure 1). The selection of scales is important, because at times, it is desirable to show detailed variations in flood flows; at others, variations in base flows. Sometimes, more than one scale is used, one being ten or even 100 times another; even logarithmic scales are used.

When such records are plotted for several years, certain patterns become obvious, such as the beginning of snowfelt runoff in the north; the slow rise to a late spring or early summer peak and rather slow recession to base flow which is characteristic of streams draining high mountain areas; the effect of Sunday reductions in power plant loads, which, during a month, cause four or five reductions in flow at seven-day intervals; the effect of major reservoir storage, which may reduce flows to nearly zero during periods when other rivers are in flood. These graphical patterns and others tell stories to trained hydrologists and hydraulic engineers. It would be much more difficult to visualize this same information from tabulated data.

When the same data for a year are arranged in order of magnitude, such a curve is called a "discharge duration curve" (some examples of which are set forth in Figure 2). When curves for several years are compared, it is a simple matter to select the years with the generally highest and lowest flows and also a year which represents average conditions.

Geographic, annual, and seasonal variations in streamflow become evident when curves for various rivers and years are compared. There are, of course, many detailed methods of analysis to supplement these, but discharge hydrographs and duration curves tell much that becomes obvious to judge and jury, or boards of directors, or legislators. The results they show can be understood by those not specially trained in hydrology, but they can best be interpreted by trained hydologists. These curves are essential to intelligent river basin planning and engineering control.

DISCHARGE DURATION CURVES

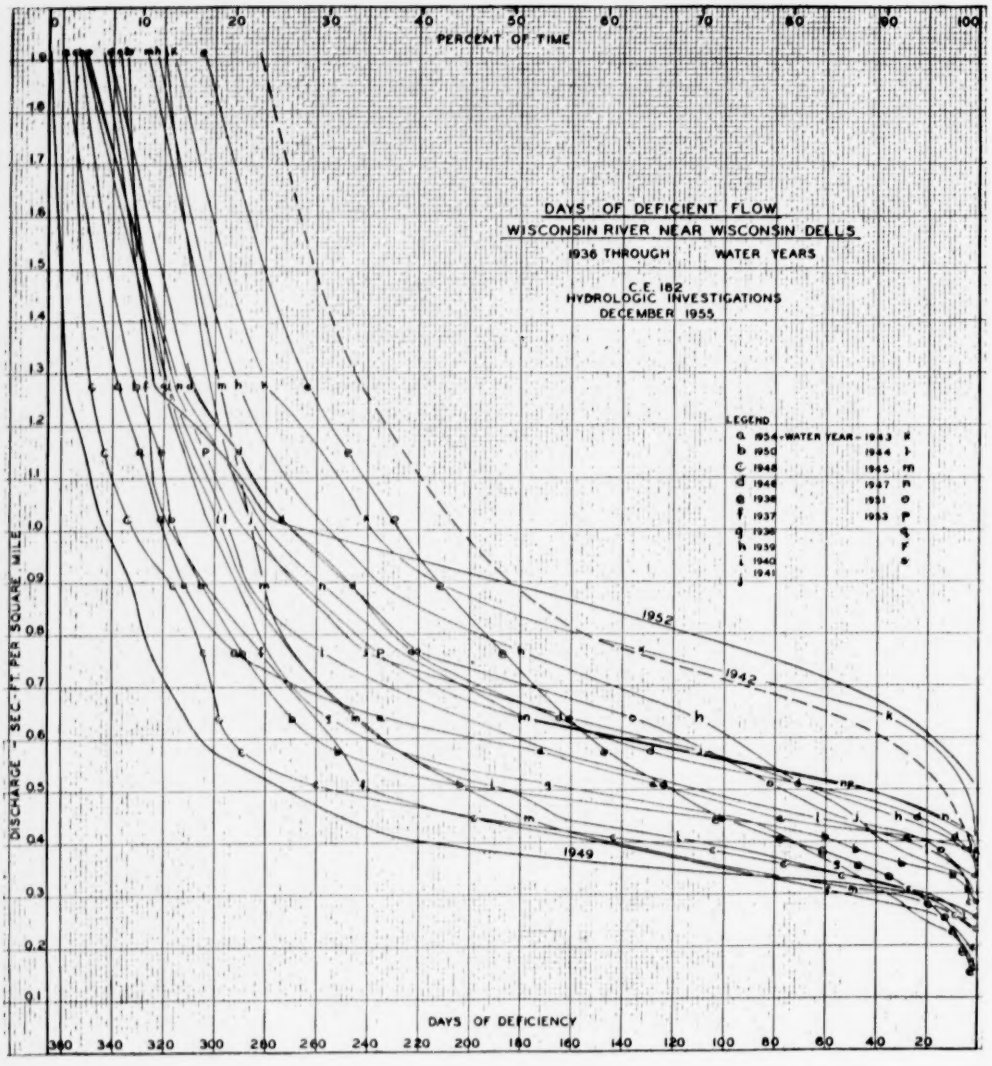

FIGURE 2

II

ENGINEERING CONTROL

A. Natural Control

Engineering control of rivers must supplement natural control if development is to be most effective. Natural control depends on such things as the shape of the basin, the stream pattern, storm paths, and storm patterns, as well as other physical characteristics of the soils, geology, etc.

The shape of the basin may be nearly circular, as is true for the Rock River basin above Afton, Wisconsin, or it may be long and narrow, like the Connecticut River basin. In the first case, flood waters from the boundary all get to the outlet at nearly the same time, independently of storm paths. In the second, the flood characteristics are much dependent on whether the storm moves upstream or downstream.

The stream pattern within the basin is also of importance. At one extreme, we have the Jefferson, Madison, and Gallatin Rivers, each draining its own relatively wide basin and converging at Three Forks to form the Missouri River. At the opposite extreme, the Clinch and the Powell Rivers drain long narrow valleys between the ridges in east Tennessee and join just upstream from Norris Dam. These latter rivers are in valleys with short steep slopes which quickly dump their water into the main rivers and create flood peaks which move at rates which can be calculated quite accurately—as TVA engineers did calculate them during the construction of Norris Dam.

When a river flows northeast in the eastern United States, as does the Genesee River in New York, melting snow and ice from the headwaters can pile up on a frozen river downstream and be aggravated by rain which falls first on the headwaters. Flash floods result. Fortunately, in the great upper Mississippi and Ohio River basins, most storms fall first on the outlets of the river basins, and the local runoff from these areas may be dissipated before rain on the headwaters enters the rivers. The direction of storm movements also has an obvious influence on this same problem. Where storms move in different directions across or along a basin, the flood peaks may have quite different magnitudes.

B. Methods of Engineering Control

Various man-made techniques, such as dams, levees, drainage, irrigation, and soil conservation, all have been used for water control. They may be used singly or in combination, and often a technique may be used in different locations to accomplish different purposes.

Dams are used to store water in river valleys, but if the water level behind the dam is held constant, the dead storage, once filled, has little effect on streamflow. Yet, this operation provides the maximum head for water power production. Moreover, it is only when the water is drawn out of the reservoir behind the dam that it becomes useful for irrigation and flood control. Only when the reservoir is full, however, does it provide the maximum potential for irrigation, and only when it is empty

does it provide the maximum potential for flood control. Thus, reservoirs are subjected to many conflicting operating demands.

Levees are used to confine flood waters and prevent them from spreading over flat lands adjacent to river channels. By confining the water, levees tend to raise the river level and this may be beneficial for navigation. Yet, confining a river all along its channel raises the flood level and the required levees to heights greater than would necessarily be the case if only occasional levees were constructed.

Drainage depresses the groundwater level and thereby helps render low land more suitable for agricultural and other purposes. Waters are discharged rather slowly, so there is little effect on rates of river flow, except when drainage waters flow into small creeks with little or no natural flow. The land itself, however, is greatly affected by drainage.

Irrigation, of course, greatly affects the land to which the water is applied, and the withdrawal of irrigation water from a river can significantly affect streamflow rates, because where irrigation is practiced, water in rivers is usually scarce and any depletion is noticeable. The storage of flood waters is usually quite necessary for dependable and successful irrigation from surface runoff.

Soil conservation by means of contour plowing, strip cropping, and the planting of soil and water-holding crops is of value in retaining the water as well as topsoil on the land. It is difficult, however, to measure the benefits in terms of inches of water or dollars per acre.

C. Problems of Water Use and Supply

1. *Domestic and Industrial Water Supply*

Although a man only drinks about five pints of water a day, his other uses of water in the community in which he lives increase the average demand on municipal water supplies to 150 gallons per capita per day, of which total residential, commercial, and industrial demands each account for a third. In the West, where lawn-sprinkling is a necessity, many communities must supply even higher requirements.

East of the hundredth meridian, municipal demands for water are ordinarily met with relative ease, except in a few instances, such as New York and Philadelphia, for example, where demands are very large, water collecting systems are elaborate, and water must be transported long distances between source and distribution. Most of the large cities in the East and Midwest are on the Great Lakes or on large rivers, and water supplies are adequate. Chicago, Cleveland, Detroit, Milwaukee, Cincinnati, and St. Louis, to name just a few, have adequate supplies, and their water demands for municipal uses other than waste disposal have little effect on other uses of water in the river basins.

In the West, however, conditions are quite different. In the dry areas, large cities must, of necessity, go greater or lesser distances to insure a suitable water supply, and even smaller communities have water supply problems much greater

than those experienced by communities of similar size in the East. Los Angeles, from the first, had its problems and is now supplied in part from the Colorado River, through the great Los Angeles Aqueduct, by waters stored behind Hoover Dam. In this region, water demands for domestic supplies have profound effect on other uses for water.

Ground water supplies many communities with an adequate source of pure cold water at low cost. Such sources, however, are sometimes endangered by contamination from wastes of the municipality itself, industries, or even farms or ranches. And increased use of ground water for air conditioning can lower the water table to such an extent that pumping costs may increase to several times the original cost and may even reduce the supply available for normal usage. Return of water from air-conditioning systems may also warm the ground water to such an extent that it becomes useless for that and other purposes. Ground water supplies, accordingly, must be protected for the most important uses in any river basin plan.

Industrial demands for water are also great and must be supplied if our present civilization is to continue. About 100,000 gallons of water are used in the manufacture of each automobile, and 770 gallons are required for each barrel of oil used by that automobile. From 60,000 to 85,000 gallons are used to produce each ton of wood pulp used in the manufacture of a morning paper. Almost all manufacturing processes, in fact, demand water.

These water demands may be for consumptive or nonconsumptive use. Water used for power turbines in hydroelectric generating plants is unaffected in quantity or quality, so this is perhaps the highest of all nonconsumptive uses. Water used to condense steam in a large power station is not used consumptively, nor is its quality impaired, but its temperature is raised. Various uses could be described, and as one goes down the list, it would be evident that appreciable amounts of water are actually combined with the product, as in the canning of foodstuffs, for example, and necessary consumptive uses result. Yet, even in a cannery, much of the water is used for sanitary protection of the product and is returned to the hydrologic cycle in nearly the original quantity, but contaminated by wastes.

Water quality, then, is also important in water-use planning. Quality may depend on either bacterial or mineral content, and water may be unsuitable as a supply for either or both reasons. Domestic water supplies must be free of bacterial contamination, but the mineral content may be fairly high. Thus, many groundwater supplies, despite a high calcium content, are used for domestic purposes. These same waters, however, are entirely unsuitable for boiler feed water without softening. On the other hand, completely soft water with moderate bacterial contamination would be suitable for boilers, but unsafe for human consumption. Data on the mineral content of river waters is published in certain of the *Geological Survey Water-Supply Papers.*

2. *Stream Pollution*

Water is also used to dispose of our domestic and industrial wastes. In the early days, simple dilution of the relatively small amount of wastes to be disposed of was

sufficient. The oxygen demand was so slight that the dissolved oxygen content of the streams was not lowered to levels dangerous for fish life, and the waters never became offensive. Later, however, these oxygen demands became so great that in some instances, all the oxygen in a stream was used and it became a flowing cesspool. But recently, by the use of primary and secondary treatment of wastes, it has become possible materially to reduce the oxygen demand of the effluent of treatment plants to such amounts that the oxygen depletion of streams is held within safe limits. The oxygen demand is expressed as B.O.D. (Biochemical Oxygen Demand), in units of ppm. (parts or pounds (of demand) per million pounds (of water)). If more million pounds of water are available for dilution, the oxygen demand can be satisfied more easily. Therefore, the minimum streamflow rate is of greatest importance, particularly at times of greatest rates of waste disposal. Dry-weather streamflow can be augmented by water storage, so planning for this use of a river is of great importance.

3. *Navigation*

Adequate depth must be provided at all points in the navigation channel of every river and canal used for shipping. This depth can be obtained by dredging the channel bottom, or it can be obtained by raising the water surface. During flood periods, the water level is high, and rivers such as the Ohio can be navigated without the use of navigation aids to raise the water level. During low-flow periods, however, low dams are used to raise the water level over shoal areas. The river profile then becomes a series of steps, and boats must be passed through locks to get from one slack water-pool level to another.

This type of navigation improvement has little effect on other water uses in a river basin. The water level in the river is maintained at or above a minimum level. As the flow increases to flood conditions, gates control the water behind the dams so that the levels change slowly and are generally held to maximum elevations not greatly different from those which would occur if no dam existed. The dams, therefore, exert little or no influence on flow rates or maximum flood elevations. They do maintain minimum elevations, however, and this benefits pumping plant intakes which draw water from above a dam.

When barge tows must go through many locks with small lifts, the time required can add appreciably to the cost of transport. Modern design calls for the replacement of a series of small dams and locks with one which provides a single lift of equal magnitude. Somewhat greater land areas are flooded, but otherwise there is little difference in operations.

Levees also can be used to raise the surface level of a river by confining the flow to a narrow channel. And cutting off bends can make shorter navigation channels and provide deep regular canals to replace shallow meanders. These navigation aids can help in flood protection, too, if properly designed for both purposes.

Elimination of low flows in rivers is another method of raising the water surface. With given channel conditions in the shoal areas, engineers can determine what

minimum flow is required to provide the necessary navigation depth. If the natural river flow is insufficient, the rate can be increased by the release of water from storage reservoirs, such as Fort Peck on the Missouri, for example. From estimates of the lowest natural flow to be expected and the durations of the drought and navigation seasons, it is possible to compute the volume of storage needed. This may be provided in one or more reservoirs on the main river or its tributaries. Certain complications arise because of the time required for storage releases to get to the point required, however, and forecasting of flows and river stages is an important feature of such operations.

Storage water released to aid navigation is obviously of no use for irrigation purposes, unless the irrigation withdrawal is downstream from the critical reach for navigation. Releases for navigation which maintain flows above a certain minimum are helpful in the abatement of stream pollution, however, providing the greatest waste concentration is not added at times outside the navigation and flood seasons. Reservoirs designed to provide water for navigation only may also be helpful in the control of floods, but they will be of little help if the flood comes when the reservoir is full at the beginning of a navigation season. Maintaining a minimum flow greater than the natural minimum without water storage is very helpful in hydroelectric generation, too, because it increases the firm power capabilities of plants all the way down the main stem of such rivers as the Tennessee or Columbia, for example. If the navigation season is only in the summer, however, and the minimum flows are not maintained during the winter when power demands are greatest, there will be no true increases in firm power production.

4. *Flood Control*

Traditionally, man has protected himself from rising flood waters by erecting a wall or levee to keep the water from his home and property. Along the lower Mississippi River and in many other places, this method has been used successfully. Originally, the first protection was provided for the property of highest value, and ring levees around cities or those which surrounded cities on the river side and tied into high banks on the land side proved quite effective. These levees constricted the river channel in their vicinity, however, and created a control section which raised the flood-water level by an amount proportional to the amount of constriction.

In time, it was inevitable that levees would be extended up and downstream until the river was entirely confined. Oversimplifying complex hydraulic interrelations, two things may be said to have resulted: (1) for a given flood, the river level was raised between levees, because with the river width restricted, the depth had to be increased to accommodate the same volume of water; and (2) the flood volume moving down the channel was increased, because water which previously had been temporarily stored on the flooded river banks had to run down the channel between the levees. As levee systems grew, therefore, the levee heights were raised; and when foundation conditions permitted and sufficient money was available to build

levees to the height necessary, they were used to protect areas against floods of even the greatest magnitude.

Economic considerations, however, often dictate that certain other plans be used to augment a levee system. One way is to provide auxiliary floodways parallel to the main river as secondary channels to divert some of the water during the heaviest floods. Where physical conditions permit, these channels are closed off by gates, as at Bonnet Carré on the Mississippi River above New Orleans, or by fuse plug levees, which are overtopped and wash out when the river reaches a certain height. Agricultural areas within the floodways may be used to yield crops during most years, but they are subject to occasional flooding which is necessary to protect other lands which presumably are of greater value.

Flood-control reservoirs to store part of the water volume and release it after the flood peak has passed have also proved effective when physical conditions permit. For example, the Miami Conservancy District in southwestern Ohio has a series of dams, each of which is built with a fixed opening, like a culvert pipe, through which the river ordinarily flows. The opening is of such size that it limits the flow to the capacity of the river channel downstream. When a flood occurs and the flow exceeds the outlet capacity, the excess volume is stored behind the dam and gradually fills the reservoir until inflow becomes less than the outlet capacity and the reservoir drains. These reservoirs are large enough to accommodate a flood forty per cent greater than the great 1913 flood, which took more than 300 lives and caused damage exceeding $100,000,000. Emergency spillways will pass even greater floods and protect the structures, but flows will then exceed the river channel capacities. Lands in the reservoir areas are used for agricultural purposes when not covered by flood waters.

Most flood-control reservoirs are constructed with gates and depend on control by man to govern their operation. The wider such control can be extended, the greater the benefit that can be effected; but such control is subject to the limitations in man's knowledge and the influence of pressure groups. By combining the use of reservoirs for flood control with use for power, irrigation, and other purposes, a substantial part of the cost can be repaid out of earnings. Such multiple-purpose operation, however, will be discussed later.

"Upstream engineering," by the construction of farm ponds and erosion-control structures and the adoption of agricultural practices such as contour plowing, strip cropping, and terracing, are useful for their primary purpose of providing an agricultural water supply and holding valuable top soil on the land where it is needed. When an attempt is made to evaluate this work in terms of basin-wide planning, however, one encounters arguments pro and con which are beyond the scope of this discussion.

5. *Water Power*

The power available from a river is directly proportional to the flow through the turbines and the head which is acting on the turbines. If the power is expressed

in horsepower, it is just slightly less than one tenth the product of the flow (Q) expressed in cubic feet per second and the head (H) expressed in feet. Expressed in kilowatts (KW), the power is about one-fourteenth $Q \times H$.

It becomes evident, therefore, why engineers seek in every possible way to increase the head available at a water-power plant and to hold the upstream water level at the highest level at all times. When stored water is drained from above the power dam, the water level falls. When the head is reduced to one-half the original amount, the power output of the plant is reduced to one-half the original amount, even though the same volume of water is used with both heads. For maximum power production, it is essential that there be no reduction in the headwater level, except possibly when small amounts of stored water are withdrawn immediately prior to spring floods which can be predicted with certainty.

Within the limits of the plant capacity, a single-purpose water-power plant uses the flow of a river as it comes to the plant, and flow regulation is rather limited. If, however, the upstream pool or pond (reservoir) has large size relative to the demand rate, it is possible to regulate the power output and, consequently, the river flow downstream from the plant over a period of one week, without any great effect on the headwater level and the power output. Then, ponded water is slowly used in excess of inflow for the working days of a week and replaced on Sunday and possibly Saturday, when water use is less than inflow. This use of pondage, of course, has no effect on seasonal streamflow variations or those of greater magnitude during extended droughts.

When large storage reservoirs are built to catch flood waters and release them gradually during dry periods and are designed to be drained completely, it is seldom economical to install power units at the dam because of the low head and power output available for a major portion of the time. On the other hand, if the outlet at the dam can be discharged into a pipeline or tunnel and additional fall developed by building the power house at a lower elevation downstream or even in a different watershed, it may be very economical to combine a storage reservoir and power plant. Moreover, storage reservoirs which increase the dry-weather river flows benefit all water-power plants downstream; and when they are operated by private or quasi-public agencies, as in the Wisconsin and Chippewa River basins in the state of Wisconsin, toll charges are made in proportion to the benefits received by each water user.

Water releases for power can help navigation, aid in the control of the stream pollution, and provide water for domestic and industrial uses, because power plants require water throughout the year. They can be helpful for irrigation also, but it must be remembered that when a consumptive use, such as irrigation and some domestic and industrial uses, removes water from a river, that water is no longer available for water-power plants downstream from the point of use. A possible exception is that of return flow of irrigation water which results from seepage from canals and water applications in excess of vegetative use. Irrigation return flows

are delayed in transit, however, and may or may not return when they are of benefit to the water-power plants.

Water releases for power must be replaced during flood periods, and the water so stored reduces the amount of flood waters which flow downstream. This reduction in volume often reduces the peak rate of flood flow also; but this is not necessarily so, because the reservoir, if it is small, may become filled with the first part of a flood and have no effect when the peak flow passes down river.

6. *Irrigation*

Both surface flows and groundwater are used for irrigation. The simplest method is to divert a river to a canal which falls very slowly as compared to the original river channel and, at some distance below the point of diversion, apply the water to lands which lie below the canal and above the river. No pumping is required, because flow is by gravity. When small amounts of water are taken from large rivers, the physical problem is simple, although the legal one may be quite complex.

Streamflow characteristics are important when more than the minimum river flow is to be diverted, and storage reservoirs must be used if any major part of the annual water yield is to be diverted for irrigation. In much of the United States, the irrigation season is limited to the summer and early fall, so that water releases primarily for irrigation are not of great value for water power unless supplemented by additional water releases for power, navigation, and other purposes.

Other consumptive uses of water are in direct competition with irrigation and generally are not compatible, although they may be coordinated, particularly if they do not occur at the same time.

7. *Drainage*

Drainage projects are greatly influenced by other water uses, because an area to be drained of excess water must first be protected from flood waters contributed by outside areas. Then, a system of open ditches or tile drains must be installed to remove the water which remains. Finally, an outlet for the excess water must be found. If this outlet can discharge by gravity into an adequate creek or river, it is possible to eliminate the pumping plant which would otherwise be necessary and save the cost of pumps and the power required to run them.

The effect of drainage projects on other water uses is of lesser importance and is frequently beneficial rather than destructive. Drainage provides a place where falling rain can be stored to prevent immediate runoff. Water is discharged from a drainage project rather slowly, over a long period of time, and frequently at a fixed rate determined by pumping capacity or the design of certain control works. Thus, a drainage project may act to retain excess water in exactly the same manner as certain flood-control projects are designed to act.

Drainage may also provide streamflow additions at times when they are needed for pollution control, water-power production, or irrigation needs. These additions, however, may not be of the quality necessary for irrigation water. This is particu-

larly true when drainage is from alkali soils and results from over irrigation of desert regions.

8. *Soil Conservation*

Engineering methods of water control for soil conservation are primarily limited to the construction of erosion-control dams and the construction of terraces. Contour plowing has much the same effect, but this can hardly be called an engineering method.

An erosion-control dam consists of a concrete or stone spillway structure by means of which water is conducted from a higher to a lower level without destructive erosion on the way down. The spillway is supplemented by an earth-fill dam where necessary to confine the flow of water and concentrate it. These dams are built across deep gullies or at their heads to prevent them from eating back upstream each time high flows concentrate at the earth drop-off point. In badly eroded regions, hundreds of such structures are necessary to stop this type of erosion. However, sheet erosion of the top soil will continue independently of the gully erosion unless some cover crop is planted to hold the soil in place.

In plowed fields on moderate and steep slopes, terraces are often constructed along the contour to break up long slopes, from hilltop to valley, into a series of shorter sections. Each of these is short enough so that water flowing down the slope does not attain erosive velocities. The terraces, therefore, reduce the amount of sheet erosion. Water collecting in the terrace flows along it perpendicular to the slope, until it reaches a terrace outlet which permits the water again to flow down the slope in specially protected, nonerodable channels of sod or concrete.

These conservation methods hold back moderate amounts of water and tend thereby to increase infiltration. Their influence on other water problems is less than is sometimes supposed, because their water-holding capacity is limited and proportionally more effective on the smaller floods.

9. *Multiple-Purpose Projects*

In recent years, when large dams and storage reservoirs began to be constructed, when water resources began to be regarded as increasingly important, and when increased construction costs made it necessary to secure support from many sources, multipurpose projects became popular. In essence, they may be said to be quite effective and economical in satisfying several water uses, but they are not as effective as a series of single-purpose projects could be at much greater cost.

Let us take as an example a high dam with a large reservoir designed for flood control, water power, navigation, domestic and industrial water supply, stream sanitation, and irrigation. Let us assume that the greatest flood danger occurs in December and January, the maximum power demand occurs in December, the navigation season extends from April through October, water-supply demands are uniform through the year, malaria control demands occur in summer, and irrigation demands increase from June 1 to the end of July and decrease to nothing by the end of

September. Theoretically, the reservoir operations might follow a pattern like this:

The water level would never be permitted to rise above the elevation of the spillway crest, except when such a rise were necessary to pass flood waters. Gates fifteen feet high would control these floods and could hold the water that much higher throughout the year. The five per cent this would add to the annual power output if the crest were 300 feet above the river downstream would be charged to flood-control costs. In addition, by January 1, the water level would be drawn down forty feet more to accommodate the expected January floods.

During January, the reservoir would be filled by the expected floods, and the water stored would reduce or eliminate flood damage downstream. If necessary, part of the top fifteen feet of the reservoir capacity would be used to store these flood waters, but that part would be emptied as quickly as possible after the flood danger had passed in order to maintain that storage as a reserve for emergencies which cannot be predicted.

In the period February through May, the worst flood threat would be assumed to be over, and so the water would be held at crest level and the power units would operate at design capacity. There would be no demand from storage for navigation, irrigation, or malaria control. This would generally be a high-flow period, and power would benefit most from reservoir control which would permit the carrying of peak demands much in excess of natural streamflow, if the water were replaced at times of low power demand.

Beginning in June, or earlier if natural streamflow were deficient because of low rainfall, navigation and irrigation demands would necessitate releases of storage water. The required releases might be the sum of the two demands or somewhat less than that amount, depending on the location of irrigation diversions, tributary inflow locations and rates, critical navigation problem reaches, and similar factors. These releases would lower the headwater level behind the dam and thereby reduce the power output. On the other hand, these same releases would be passed through the turbines and would produce extra power during these months because of the extra flow available, although the power operators would prefer to have this extra power in December, at the time of peak power demands. Because of the malaria-control demands that have been assumed, the rate of release would be greater than average for five or six days each week and less than average for one or two days. The reservoir level would then be fluctuated up and down to prevent the formation of stagnant pools in which mosquitoes might breed. This is most important when reservoir level fluctuations are small. Irrigation demands would be over by the end of September, but navigation demands might continue until the end of October or November in northern regions and throughout the year in the South.

If the various demands had removed enough stored water to make room for expected December floods, no further reduction in reservoir level would be necessary. Otherwise, further releases might be necessary in November to reduce the headwater level to the required elevation.

In December, the reservoir would be down to the lowest level when power operators would like it at the highest level. With the hydrologic and operating conditions assumed, however, floods in December might provide excess flow which would offset, to some extent, the deficient head. This would require excess generating capacity, which would add to the capital cost.

Domestic and industrial water-supply demands would have major or minor influence on the above operating schedule, depending on their magnitudes and variability. Small uniform demands would have little influence; large demands create the primary purpose for regulation.

Multipurpose operation of a single reservoir, thus, is obviously not simple, but it should be noted that the control of water at dozens of dams, as in the TVA system, for example, is extremely complicated. Some of the reservoirs in the tributaries, Norris, Fontana, Hiwassee, and others, are multipurpose. Others, also on the tributaries, Nantahala, Blue Ridge, Calderwood, for example, are better operated as single-purpose reservoirs which are coordinated with the multipurpose reservoirs. Finally, the main river dams from Knoxville to the Ohio River are operated to maintain navigation levels, produce power, and assist in flood control. The control of such a system is dependent on "rule curves," which show the probable minimum water level for any date in the year, the normal operating level, the maximum multipurpose level, and probable maximum level under extreme flood conditions. Operating within these limits, engineers decide when to drain, when to fill, when to carry power load at one dam or another, and many other associated problems.

III

CONCLUSION

The engineer's roles in river basin development are thus seen to be pervasive and long-continuing ones—extending from the conduct of hydrologic surveys to the planning, construction, and operation of water-control works. Valuable as these contributions may be, however, the ultimate success of a river basin development program will primarily be determined by the manner in which and the ends to which these ancillary services are employed.

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THE ECONOMIC DYNAMICS OF RIVER BASIN DEVELOPMENT

WILLIAM E. FOLZ*

It would be comforting if, in an article such as this, one could promise the elucidation of a method or a model for predicting the nature, the chronology, and the extent of the economic expansion likely to occur if the development of a river basin is undertaken. The writer must, however, at the outset, disclaim and discourage any such hope. Indeed, much the better part of valor would have been completely to forego exploration of this nebulous area; but so many of the benefits ascribed to river basin development depend upon its expected economic consequences that these matters could not conscientiously be ignored. Accordingly, an attempt will be made here to delineate—albeit roughly—the economic dynamics of river basin development.

Despite the evolution of a theoretical framework that would facilitate analysis,[1] economists have devoted scant attention to the role played by natural resources in the inducement of economic expansion.[2] As has been observed, "There is no received theory of economic development."[3] This is particularly surprising in the light of analogous developments in economics and allied sciences. Thus, the theory of interest and capital accumulation has been minutely explored;[4] technology and its influence on economic dynamics has likewise carefully been studied;[5] and labor theory and the effect of wages on economic expansion have also rigorously been analyzed.[6] In a similar vein, Turner's emphasis on the frontier and its significance to the growth of

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[1] See Folz, *The Theory of the Relation of Resources Development to Economic Development*, in WATER RESOURCES AND ECONOMIC DEVELOPMENT OF THE WEST 1 (1953).

[2] HENRY GEORGE, PROGRESS AND POVERTY (1879) was posited on the thesis that land and resources were the most significant factors influencing economic development. The effect of this book upon economists, however, was to induce them to deny that land was in any way different from other factors of production. John Bates Clark, for example, applied the law of diminishing returns, which had previously been considered the exclusive property of land rent, to other factors of production, and although he recognized the monopoly attribute of land, he maintained that it was of little importance. See 2 JOSEPH DORFMAN, THE ECONOMIC MIND IN AMERICAN CIVILIZATION 198 (1949). See also ALVIN S. JOHNSON, RENT IN MODERN ECONOMIC THEORY (1902); J. J. DAVENPORT, THE ECONOMICS OF ENTERPRISE 178-208 (1913). After this charge against the foundations of the theory of rent, later economists sought to re-establish the older theory. See, *e.g.*, ALFRED MARSHALL, PRINCIPLES OF ECONOMICS 415-23 (1930). But none seemed eager to venture into the controversy to the point of overemphasizing the importance of land. See RICHARD T. ELY AND GEORGE S. MEHRWEIN, LAND ECONOMICS 1-112 (1940); ROLAND R. RENNE, LAND ECONOMICS 3-100 (1947).

[3] Schultz, *The Economic Development of Our Western Interior*, 35 J. FARM. ECON. 707 (1953).

[4] See EUGEN V. BOHM-BAWERK, POSITIVE THEORY OF CAPITAL (W. Smart transl. 1890); GUSTAV CASSEL, THE NATURE AND NECESSITY OF INTEREST (1903); IRVING FISHER, THE THEORY OF INTEREST (1930).

[5] See JOSEPH SCHUMPETER, THE THEORY OF ECONOMIC DEVELOPMENT (1934).

[6] See F. W. TAUSSIG, WAGES AND CAPITAL (1896), and OUTLINES OF A THEORY OF WAGES (1910); LIONEL ROBBINS, WAGES (1925); J. R. HICKS, THE THEORY OF WAGES (1932).

democracy and economic expansion[7] has occupied the minds of historians and political scientists for over a generation.[8] And the new science of geography, too, has been finding fresh bases for emphasizing resources as the cause of economic expansion.[9]

It is beyond the scope of this article to inquire into the reasons for economists' failure to emphasize resources as an inducement to economic expansion. Perhaps they have felt that all that can be said either is obvious or has already been said. Perhaps they also have reasoned and wished to stress that resources are assets that a country either has or does not have and about which it can do nothing, while technology and capital, for example, are elements of wealth that can be increased to the advantage of even a country with limited resources. Nor is it the writer's intention to criticize economists for not elaborating this area more intensively. These introductory remarks rather purpose to underline the fact that when an economist seeks to explore the effects of resources on economic expansion, he has a comparatively limited body of theory upon which to draw. He must, instead, develop his own theories with the tools available, which, for the most part, were forged to fashion somewhat different products.

I

THE INDUCEMENT OF ECONOMIC EXPANSION

An inquiry into the influence of river basin development on economic expansion can, perhaps, best be initiated by a determination of the types of resources that are likely to be created or enhanced by such development and then an evaluation of these resources as dynamic economic prime movers.

Most river basin development provides water to irrigate newly opened lands, to supplement existing water supplies available to already developed lands, and for domestic and industrial uses, health, and sanitation. Storage dams constructed to furnish these utilities may also further provide for the regulation of the water level for navigational and flood-control purposes, for the generation of electricity, and for recreational facilities in the artificial bodies of water that are frequently created.

In evaluating these products of river basin development as factors inducing economic expansion, it is necessary first more precisely to define the area of analysis.

[7] FREDERICK J. TURNER, THE SIGNIFICANCE OF THE FRONTIER IN AMERICAN HISTORY 197 *et seq.* (1894).

[8] See, *e.g.*, FREDERIC LOGAN PAXSON, THE LAST AMERICAN FRONTIER (1910); B. H. HUBBARD, A HISTORY OF THE PUBLIC LAND POLICIES (1910); F. A. OGG, THE OLD NORTHWEST (1921); J. D. HICKS, THE POPULIST REVOLT (1931); THEODORE SALOUTOS AND J. D. HICKS, AGRICULTURAL DISCONTENT IN THE MIDDLE WEST (1951). For further discussion of Turner's influence on history, see Wright, *Political Institutions and the Frontier*, Craven, *The Advance of Civilization into the Middle West in the Period of Settlement*, and Hicks, *The Development of Civilization in the Middle West, 1860-1890*, in DIXON RYAN FOX (ED.), SOURCES OF CULTURE IN THE MIDDLE WEST: BACKGROUNDS VERSUS FRONTIER 15, 39, and 73 (1935).

[9] See, *e.g.*, AMERICAN GEOGRAPHICAL SOCIETY, NEW ENGLAND'S PROSPECT (Special Pub. No. 16, 1933); ERICH ZIMMERMANN, WORLD RESOURCES AND INDUSTRIES (rev. ed. 1951); Baker, *The Increasing Importance of the Physical Conditions in Determining the Utilization of Land for Agricultural and Forest Production in the United States*, 11 ANN. ASS'N AM. GEOGRAPHERS 17 (1921); Zierer, *An Ephemeral Type of Land Occupancy*, 31 *id.* at 125 (1936).

Water resources may become depleted in a rapidly growing area; like land in an area where population is growing rapidly, water may become a scarce resource. When scarce, there is competition for its uses, and its marginal value productivity increases. New sources of water supply are then sought, and if the supply is increased, it is usually available only at greatly increased costs. If additional water supplies are not made available, water may become a limiting factor to economic expansion—and such situations are increasing. Thus, for example, certain parts of California are already facing an arrestment of growth owing to water shortage; and the future growth of the populous industrial areas in the East will largely depend on their ability to restrict those uses of water the marginal utility of which is lower than that of urban development uses. Problems of this type are unquestionably significant, but they arise only where growth is already occurring. The problems are quite different in areas where growth is either slow or arrested, and where river basin development may be expected to afford some stimulation. It is with this latter type of situation that this article will concern itself.

When economic expansion is considered, distinctions must also be drawn between the growth of primary industries, those industries that are resource-oriented, and the superstructure of industries, which, in turn, are induced by the primary industries. Although this article will concern itself with the entire growth factor, attention in this part will be focused exclusively on the location of primary industries.

Finally, further to clarify the definition of this study, other relevant factors will be regarded as remaining constant. Thus, climatic factors neither so severe nor so attractive as unduly to retard or stimulate growth will be assumed, nor institutional factors concerning laws and customs significantly different from those in the rest of the country. Similarly, the population will be assumed to be possessed of the same ability as the population in other regions.

Within this framework, an analysis of the probable effect of supplying the combination of utilities usually associated with river basin development may proceed.

Irrigated farms for settlement by homesteaders are probably the most efficient of the products of river basin development in inducing economic expansion. Land for farms is always in great demand. This was the case even when a vast frontier existed in this country and when there was no apparent limit to land available for farms; and it is probably even more so today, when available new farm land is scarce. This seems paradoxical when farm surpluses are faced in every commodity and the cost of settlement, in terms of labor, money, and privation, is so great. Indeed, most settlers today can, at best, hope to make an adequate living only after eight to ten years of hard work and subnormal living conditions; and the statement is frequently heard that it takes three failures to make one success on an irrigated farm.[10]

[10] Based on informal interviews with surviving first settlers in the Twin Falls Project, Twin Falls, Idaho, conducted by the writer in preparation for a study of reclamation in Idaho. The most complete study of settler experience, however, is being made in the developing Columbia Basin Project. In WASHINGTON AGRICULTURAL EXPERIMENT STATION INSTITUTE OF AGRICULTURAL SCIENCES, THE COLUMBIA BASIN SETTLER: A STUDY OF SOCIAL AND ECONOMIC RESOURCES IN NEW LAND SETTLEMENT (Bulletin No.

With such a prospect confronting them, then, why do settlers seek these farms and consider themselves fortunate if they win one in a drawing?

Probably the most important single reason underlying this demand for farm land is the widespread willingness of individuals to accept a lower income in farming than they would in any other economic pursuit, owing, perhaps, to the supposed compensatory advantages of farming as a way of life. On newly developed lands, there is also the long-run prospect of significant capital gains. Throughout our history, land values have invariably reached a new peak each generation. The anticipation of such possible appreciation of one's capital assets does not exist in many other occupations open to the average citizen. And finally, the settlement of new lands does not require more capital than individuals with ordinary means can amass. This greatly broadens the market for new lands, for as the economies of scale of most businesses operate to increase their initial capital requirements, fewer opportunities exist in such businesses for individuals of moderate means.

River basin development which provides for new lands for settlement, therefore, will be sure to attract homesteaders into the project area, even if there are serious obstacles to overcome in bringing new farms into production and marketing their products. Will other resources made available by river basin development, however, be equally dynamic in inducing economic expansion?

Water power is an energy resource—in fact, the most important single resource in the electrometallurgical and electrochemical industries. But in other industries, although electricity may be substituted for other energy resources, it is not so important a factor as alone to determine the location of plant sites—in fact, expenditures on electricity are usually so small in most industries as to constitute an almost negligible factor as compared with labor or markets in this regard. Moreover, when unused electric power capacity abounds in other sections of the country, there is little likelihood that additional capacity will be installed in newly developed areas. Accordingly, cheap electric energy cannot be expected to attract industries, even of the electroprocess variety, during periods of less than full employment.

Most electroprocess industries also require large capital investments, thus limiting entry into the field—and the consequent industrial demand for electric power—to well-established businesses with large capital assets and experience. Furthermore, even if a new enterprise could surmount this initial difficulty, it still would face the problem of monopoly or, at best, oligopoly. For, although the economics of location might designate a new area with vast quantities of cheap electricity as the logical

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566, 1956), an analysis was made of the economic position of new settlers. This project has been accompanied by less privation on the part of settlers than occurred in earlier developments. *Id.* at 32. Nevertheless in 1954, one-third of the settlers had annual incomes of less than $2000. *Id.* at 25. In an unpublished report prepared by one of the authors of this study, it further appears that those who had settled on the land prior to 1948 had annual net incomes of $5700-$6900; those who had settled 1952-53 had annual net incomes, depending on the size of their operations, of $170-$1113; but those who had settled in 1955 had negative annual net incomes averaging $1000. B. D. PARISH, REPORT ON SETTLER PROGRESS: COLUMBIA BASIN PROJECT 12 (1956).

place to build new facilities, oligopolists with plants in other areas might adopt or threaten to adopt price policies designed to discourage such undertakings.

Nor should undue reliance be placed on the recent successful experiences that have accompanied basin development in the Pacific Northwest and in the Tennessee River Valley. Although new industries did, in fact, develop in those areas in the face of competition with older established industrial regions, this phenomenon coincided with World War II. In the Pacific Northwest, in particular, most of the basic plants were built, in the first instance, through public investment in war plants, and most of the industries which use the products of these plants have also been government-financed and sustained.[11] Possibly such growth might have occurred had not the war supervened, but such a conclusion would be highly suspect.

There is, of course, some possibility that industrial location can be induced in new areas by promotional rates for electricity. If the power company would so adjust electricity rates as to persuade established industries to write off their investments in plants in older areas and to relocate, industrial development based upon electricity might be accelerated in the new areas. It is doubtful, however, that promotional rates of such magnitude could be established, especially by a governmental agency, without inciting political repercussions from the adversely affected areas—those losing the industries.[12]

Thus, although possibly significant in the electroprocess fields, cheap and abundant electricity would seem somewhat less certain to induce location in an area than would new agricultural land. But if it is doubtful that water power is an autonomous force in inducing economic expansion, the other products of river basin development are even less so. Water transportation along the inland rivers, for example, has long ceased to be of prime importance in locating industries. The points of origin and of distribution are too limited to encourage much trade, and where transshipment by railroads or trucks is also involved, the purported economies are soon lost. The cost of flood control or the possibility of floods, too, may be a deterrent to economic expansion, but flood control in itself cannot be a significant prime mover in economic expansion.

As national income has risen and leisure become more widely enjoyed, recreation has come to be considered a resource of increasing importance. It is difficult, however, to place a market value on a resource, such as this, for which there are no direct sales. Economically, this type of resource can be evaluated only indirectly—through

[11] See WILLIAM E. FOLZ, AN ANALYSIS OF THE INCOME STRUCTURE OF IDAHO 91 (1952).

[12] Protests were made by business groups against the establishment of promotional rates by the TVA designed to lure northern industry to the South. The protests were so vigorous, in fact, that President Roosevelt was impelled to write a letter to Representative Thom, of Ohio, denying the charge. President Roosevelt stated in the letter:

"This is in reply to your letter of February twenty-first in which you call to my attention the report that representatives of the TVA are endeavoring to induce Ohio manufacturers to move to the Tennessee Valley in order to secure the benefits of cheap power."

"It is a definite policy of the Tennessee Valley authority that no such action be taken in respect to Ohio or any other region." 4 THE PUBLIC PAPERS AND ADDRESSES OF FRANKLIN D. ROOSEVELT 106 (1935).

the sale of goods and services required to utilize it—and economic theory and price theory have, unfortunately, provided little to guide such evaluations. Economists themselves, for the most part, have avoided the problem, and, consequently, individuals with little or no economic training have propounded solutions, albeit with little understanding of the economic issues involved.

In most areas where river basin development is contemplated, fish and wildlife abound. An additional lake or reservoir, therefore, will add little to the total value of recreation. Of course, it may draw sportsmen from other rivers and streams; it may even, for a time, encourage additional utilization of the resource by individuals from nearby communities. But most evaluations of the particular resource will, in fact, probably overshoot the mark, because what should be measured is the marginal value product, whereas all that can be measured is the average value. To be more specific, it is not economically justifiable to measure the value of an artificial lake created by a dam on a river by the amount of fishing, boating, cabins, hotels, etc., to be found there. What should be measured, instead, is the amount of additional recreational expenditure attributable to this one additional lake. Or, to state the problem differently, if this one lake did not exist, how much less would be spent on outdoor recreation? It is not logical to assume that if this one lake did not exist, all the individuals who fish or have cabins there would neither fish nor have lake cabins at all; most of them would likely utilize the next most accessible resort. If only the incremental value thus described could be measured, therefore, the contribution to recreation by any one river basin development would, in most cases, probably be quite small.

On the other hand, it is not fair to assume that the demand for recreation does not respond to an impact effect. If only a few recreational sites are available, there may be little utilization of them; but when many are made available, more people may become conscious of them, and the demand for this type of resource may, for a time, respond in a geometrical ratio to the quantity available. Even if we grant this hypothesis, however, there still remains a serious problem of how to measure the impact of any one additional facility on the entire demand.

The implications, nevertheless, clearly are that recreational facilities made available by river basin development also have a low growth-inducing power. One would be hard put to indicate a single instance where significant economic expansion stemmed from the creation of recreational facilities of the type associated with river basin development. While such services may have significant value if other dynamic factors exist, in and of themselves, they have little developmental value.

II

THE EXTENT OF ECONOMIC EXPANSION

In the foregoing part, the following conclusions have been suggested: (1) Irrigated agriculture is probably the most certain of the products of river basin development to induce economic expansion. (2) Electric power rates quite high as a prime

mover to economic expansion, but it is not as certain as irrigated agriculture to bring it about. (3) Other by-products of river basin development, such as navigation, flood control, and recreation, have only negligible potential for inducing economic expansion.

To encourage industries which utilize the resources made available by river basin development, however, is only the first step in the economic expansion of an area. Industries which are resource-oriented in turn induce the location of other industries. Thus, some industries will locate in the area because they further process the products of the primary industries; others because of the growing market based upon the incomes of individuals working in the primary and secondary industries; and still others will be purely service activities, entirely population-oriented. A mature economy is one that derives most of its income from activities other than primary or secondary industries—*i.e.,* from the manufacture of finished products, trade, finance, and services. Once the growth of a region is initiated by the location therein of farming, electrometallurgical and electrochemical plants, and other industries utilizing the raw materials of the area, then, how far will it proceed towards a mature economy?

This question is difficult to answer. There have probably been no instances in which development of a region has not been spurred by such exogenous influences as wars, public investments, discovery of valuable mineral deposits, or other equally powerful forces. Attempts have been made, however, to determine how an economy will develop by analyzing the location of primary industries and the income derived from other sources.

Two general types of empirical studies have been made. First, and by far the more impressive when viewed from the standpoint of its scientific conception, is the application of the Leontief input-output analysis to regional growth. The second method, which, although much less impressive and imaginative, still has its advantages, is the case-study approach, in which areas somewhat protected from exogenous influences are selected and the structure of their economies analyzed after a period of growth has occurred. It will not be possible here to study these two approaches in detail, but a brief summary of their methods and results will facilitate evaluation of the growth factor as it affects river basin development.

The Leontief method is based upon the general equilibrium theory developed by Walras about eighty years ago.[18] Its basic hypothesis is that all elements of an economy are interdependent, each factor being determined by all the other factors, and, in turn, affecting every other factor. For every input, there is a corresponding output; and for every output, there is a corresponding input. Thus, if a complete inventory could be taken of the entire economy for one period (say a year, as in the census years), all economic activities of a country could be classified as inputs and as corresponding outputs, every activity on the input side being measurable as a

[18] LEON WALRAS, ELEMENTS OF PURE ECONOMICS OR THE THEORY OF SOCIAL WEALTH lesson 12 (Jaffe transl. 1954).

service or a utility on the output side. By solving the equations simultaneously, the individual coefficients of each input, as it is affected by and as it, in turn, affects every output, could be determined; these would be technical coefficients, in Leontief's terminology. Once these technical coefficients were established, the impact of any change in any of the input factors on the output of the entire economy could be determined.

Leontief applied his analysis to the American economy for the years 1919, 1929, and 1939.[14] Those were years in which census data were available to give the closest approximation to statistics for an entire balanced economy. For each of these census years, coefficients were computed, based upon the input-output relationship. By taking the 1939 coefficients and applying them to 1929 and 1919 total demand, the output of the various sectors of the economy was estimated, and these estimates were compared with the actual output. The results showed surprisingly small standard errors in prediction, which would appear to indicate that the technical coefficients are fairly fixed over time.[15]

Essentially the same type of analysis has been applied to regional economies to study changes in their structures.[16] This method has much to commend it. The development of the matrix itself, however, demands that the economist analyze all the interrelations of industries in the region, as well as all factors influencing location of industry and the characteristics of the industries themselves—*e.g.*, whether they tend to be national industries (selling in national markets), regional industries (selling only in regional markets), or subregional industries (selling only in local markets). A complete input-output analysis would also include all factors entering into the regional balance of payments. Further, once the basic data for the matrix were secured, their organization for the regional model would require additional information, such as the effect of interregional competition on the development of new industries in the area, the response of demand to unusual supply, and a detailed analysis of comparative advantage. Finally, the technical coefficients derived from the economy as a whole would provide as good a basis for determining the distribution of the markets among regions as could likely be derived from any scientific analysis of this type.

There is a sound basis, then, for applying the Leontief model to the analysis of the impact of river basin development on regional growth; but, for several reasons, such a venture has never been undertaken. Before the technique can be used, as noted above, empirical data of such exactness are required that the task of compiling them would be almost prohibitive. Moreover, many of the judgments that would have to be made in supplying data for the matrix would have to be based upon untested hypotheses. For example, how does demand for the various commodities

[14] WASSILY W. LEONTIEF, THE STRUCTURE OF THE AMERICAN ECONOMY (2d ed. 1951).

[15] *Id.* at 217-18.

[16] WASSILY W. LEONTIEF AND OTHERS, STUDIES IN THE STRUCTURE OF THE AMERICAN ECONOMY cc. 4, 5 (1953). See also Isard, *Location Theory and Trade Theory Short-run Analysis*, 68 Q. J. ECON. 305 (1954).

distribute itself among the regions? Are the various regions equally dependent upon income earned within the region, or do some regions derive a greater percentage of their incomes from investment outside the region? To what extent will competition from well-established firms in one region counteract the comparative advantage of other regions? These and many other similar questions must be answered before a complete and accurate analysis of the dynamics of regional development can be described by the Leontief model. Furthermore, once the model were constructed, its conclusions would still be only tentative. Nevertheless, some of the river basin studies have required extremely large staffs, and literally small fortunes have been spent on them. Had the time and money been devoted, instead, to the development of a detailed and logical model of the Leontief type, better results might well have been achieved. There now is, however, no information developed by use of the Leontief model to aid in evaluating the effects of river basin development.

The second method that has been employed, namely, the case-study method, has provided some helpful information, but it leaves unanswered many questions regarding the dynamics of regional development. The most detailed study of this nature was made in connection with the Columbia Basin Project, where, about the time construction commenced, a group of investigators was assigned the task of appraising the economic effects of the development, of attempting to assess the full economic impact of the reclamation program.[17] The method used was to determine the cropping pattern by analyzing the soil characteristics, it being assumed that sufficient processing plants and marketing services would develop to handle the products of the soil. Estimates of population growth in the area were based upon independent calculations. The problem of marketing the products of the area was viewed as one of handling the surplus over and above those consumed by the population. This procedure was about as good as could be devised with the tools available at the time, but limitations were imposed on the studies by lack of knowledge of the extent of development apart from agriculture, which was the most dynamic factor in determining both income and population growth in the area.[18]

During the period following the onset of the depression in 1929, interest in new irrigation projects waned as it became apparent that it was not agricultural, but rather more nonagricultural investment opportunities that were needed. Accordingly, in justifying its new projects, the Bureau of Reclamation and others placed much emphasis on off-site nonagricultural developments, which were usually classified as secondary benefits. No effective way had yet been devised to gauge these benefits, however, and to afford some basis for measurement, the Bureau of Reclamation insti-

[17] JOHN A. GUTHRIE, WENDELL T. CALHOUN, AND MARION CLAWSON, MARKETS AND NEW LANDS (1942).

[18] "Forecasts of population for the region indicate an increase of around 25 per cent within the next three decades. Industrial and other developments during this war may alter the situation to some extent, but the general trend is reasonably clear. In the study here reported, it has been assumed that the regional consumption of agricultural products would increase in direct proportion to such growth in population." *Id.* at vii.

tuted a series of case studies of developed projects to ascertain the amount of income derived directly from the projects and the amount of income derived from industries and services induced by the projects.

The first of these studies was undertaken by M. E. Marts in the Payette area in Idaho.[19] This area was selected because it was a well-established project, and, consequently, had experienced ample opportunity for full development at the time the study was initiated. The Payette area would have experienced no agricultural development whatever had water not been made available, as there were no other natural resources to be exploited. So, the entire growth of the area was unquestionably attributable to the project. The results of the study showed that for every dollar of income derived from agriculture, an additional $1.27 of nonagricultural income was generated in the immediate project area.[20]

Other studies of this type followed. In November 1951, the Bureau of Reclamation published a study of the Carlsbad Project, attempting to ascertain the amount of income derived from sources other than agriculture in that area.[21] The author of this study, however, used gross value figures instead of net income figures as in the Marts study; consequently, the results of the two studies are not directly comparable. He also aggregated the values for the years 1907 through 1950, and he concludes: "The sum of the income to the farm population, the local urban and the national trade activities due to the project is about $306,622,000, or 607 per cent of the value of crops produced on the project during the 44 year period."[22] While this conclusion is quite impressive, it has little value for the purpose of evaluating river basin development.

A month after the appearance of the Carlsbad study, a report on the Yuma and Gila Projects in Arizona and California appeared.[23] This report followed the method used by Marts in the Payette study; it concluded that in the Yuma and Gila trading area, for every dollar of net income[24]

> . . . accruing to the basic agricultural industry of the area in the form of farm income and wages to farm labor, an additional net income of $1.74, indirectly attributable to agriculture, accrues to local supporting business, service establishments and their employees.

In February 1952, a study of the accomplishments of irrigation in Weld County, Colorado, was published.[25] This study showed the relationship of nonagricultural to agricultural income to be almost exactly the same as that found by Marts in the Payette area—129 per cent.[26]

[19] M. E. MARTS, AN EXPERIMENT IN THE MEASUREMENT OF THE INDIRECT BENEFITS OF IRRIGATION—PAYETTE, IDAHO (1950).

[20] *Id.* at 5.

[21] U. S. BUREAU OF RECLAMATION, DEP'T OF THE INTERIOR, AN EVALUATION OF THE EFFECT OF THE CARLSBAD IRRIGATION PROJECT ON THE LOCAL AND NATIONAL ECONOMY (1951).

[22] *Id.* at 20.

[23] U. S. BUREAU OF RECLAMATION, DEP'T OF THE INTERIOR, EVALUATION OF LOCAL IRRIGATION ACCOMPLISHMENTS, YUMA AND GILA PROJECTS' TRADE AREA ARIZONA-CALIFORNIA (1951).

[24] *Id.* at 1.

[25] U. S. BUREAU OF RECLAMATION, DEP'T OF THE INTERIOR, ACCOMPLISHMENTS OF RECLAMATION WELD COUNTY, COLORADO (1952).

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Two other studies were made for the purpose of determining the amount of indirect income generated on irrigation projects. A study of the Klamath Project followed a procedure not comparable to the others, and, consequently, no conclusion of value here can be inferred from it.[27] A study of the Newlands Project, however, followed the pattern set by the Payette and Yuma-Gila income studies, and the results were quite similar, showing an indirect income in the trading area equal to 120 per cent of the income derived directly from agriculture.[28]

From the studies made of irrigation developments, therefore, it would seem reasonable to assume that once agricultural land is brought under cultivation, processing industries, retail trade, community facilities, and service industries will develop and give rise to about 125 per cent more income than that derived from agriculture itself. But while these studies represent a start in the direction of measuring the dynamics of regional development, they fall far short of providing the basis for a complete analysis. Nevertheless, several points are clear: Agricultural developments, of themselves, do not generate great economic expansion; the manufacturing facilities that emerge to process agricultural products do not provide large payrolls; development of an area based upon agriculture does not proceed far enough to attract market-oriented industries; and, consequently, economic growth stops short of maturity. If great economic expansion is to occur, therefore, forces other than agriculture must generate it. Can river basin development supply these other forces?

Probably the most complete study of industrial development of a region was made by Edwin J. Cohn, Jr., who attempted to analyze the structure of economic growth in the Pacific Northwest to ascertain whether development would proceed to a point where high industrialization based upon electric power would occur.[29] In general, his conclusions were somewhat unsanguine. He recognized, of course, that industries of the electroprocess variety, which require vast quantities of cheap electricity to operate, did locate in the Pacific Northwest, although the extent to which this location was influenced by the war and by heavy public investments was not assessed. He observed, however, that the most striking failure of the Pacific Northwest to date has been its inability to develop industries which process the new materials provided by these primary industries. For example, according to Cohn, the Pacific Northwest is unfavorably located with respect to markets to develop aluminum-processing industries. Such enterprises require large capital investments, their power consumption is small, and they must locate close to the market and subcontracting industries. Freight rates encourage the shipment of raw materials but discourage the shipment of finished products and products of supporting industries, and the aluminum industry itself follows the practice of absorbing freight on new competing market-oriented industries. The rolling plant at Trentwood, in the suburbs of

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Spokane, Washington, would seem to refute this analysis, but had the plant not been placed on the market at a bargain by the Defense Plants Corporation, it would probably not be in operation today.

Even industries which accidentally located in the Pacific Northwest, such as the Boeing Aircraft Co., the Northwest Iron Fireman Co., Brown Industries, and Pacific Car and Foundry, have found, as they seek national markets, that they are not strategically located. All these companies, accordingly, have either established branches in other sections of the country or have contemplated doing so. The prediction, made by proponents of power development in the Pacific Northwest, that large numbers of secondary industries would locate there because of the existence of cheap metals, thus, have not materialized. The industrial development that has occurred has been confined to the primary industries and to industries dependent upon local markets. Dr. Cohn summarizes his conclusions as follows:[30]

> The development of hydro-electric resources to produce cheap power should not of itself be expected to attract industry except for that very limited class of manufacturing, the electro-process industries, which consume such immense quantities of energy that they are forced to locate with primary regard to the availability of plentiful cheap power. The employment such enterprises create is small, however, and the related industries which follow them are few. On the other hand, in regions where the lack of a firm energy base retards industrial development, the harnessing of hydro-electric or other power sources can contribute substantially to industrialization. Providing power, however, only removes an obstacle, it does not introduce a positive industrializing force.

If we accept these conclusions as definitive, the question raised at the beginning of this part seems to be answered. Except for the rather modest economic growth attributable to irrigation, river basin development cannot be expected to trigger any momentous expansion. If industrialization takes root for other reasons and electric energy is a limiting factor, such development may permit greater expansion to occur than would otherwise be possible. The pattern of economic expansion to be expected in a region where river basin development has been undertaken, thus, is the location of primary industries (*i.e.*, agriculture, electroprocess, and somewhat more intensive utilization of natural resources already there) and a growth of trade, finance, construction, and community services—and even the latter type of activity will be somewhat restricted because of the lack of a good base for support.

There is a danger, however, that this conclusion about location theory may prove too much. In the last analysis, if industrialization depends upon mass markets, and mass markets depend upon population and its purchasing power, and population depends upon economic opportunities, and economic opportunities, in their turn, depend upon industrialization, we find ourselves involved in circular reasoning. The conclusion we reach is that industrialization depends upon industrialization, which negates economic history. We know that industrialization came to the eastern coast of the United States in the face of many of the locational limitations faced by the

[30] *Id.* at 179.

Pacific Northwest today. Later it moved to the Midwest and to the South, in competition with established industries in the East. The same types of locational obstacles, it would seem, could be overcome in locating industry in the Pacific Northwest. Dr. Cohn does not deny this. He concludes only that hydroelectric power, in itself, is not a strong enough force to bring this about; there must be some other outside factors to induce industrialization.

What, then, are the other forces that will induce industrialization? Are they likely to occur where river basin development is undertaken?

Probably the most important single component of economic expansion, apart from the physical resources themselves, is population. This factor has not been considered so far because population cannot be treated apart from the economic opportunities which attract it. If river basin development increases economic opportunities, it will attract population; and population, in its turn, will attract industry. A large population providing cheap labor, for example, if combined with the existence of other raw materials, may draw industry away from older established regions, even in the face of adverse freight differentials. Similarly, a population with a high purchasing power can attract market-oriented industries; and if such population is highly concentrated and if its income is large enough, industrialization will occur even with resources that are otherwise somewhat limited. This seems to have been the case in Florida, California, and the Southwest. But population cannot grow in a vacuum. There must exist either economic opportunities to attract population in the first instance, or the population must have income from sources outside the region. In most cases of economic expansion, there exists a little of both.

Apart from industrialization, the dependent variable, the only economic opportunities a region affords are agriculture and the exploitation of resources. The exploitation of valuable mineral resources, however, such as oil, the precious metals, and rich base metal ores, usually does not result in a high concentration of population. In most industrialized regions today, industrialization rather originated with agriculture. The small diversified farms of the East and the Midwest brought population into the areas which later became industrialized. Agriculture assists in industrialization in several ways: (1) Farm population is stable, in that farmers establish permanent homes and permanent communities. (2) Farming supplies a surplus population which can migrate to nearby urban centers and provide labor for industry. (3) Since agricultural employment is seasonal, it affords an off-seasonal labor supply which encourages industries that offer dovetailing of employment to create off-seasonal demands for labor. (4) Agriculturally supported towns and cities usually provide the early and frequently the most costly stages of community facilities, such as roads, highways, schools, health, and police protection, on which industrialization can build. (5) Finally, a highly concentrated agriculture generates the beginnings of mass markets around which industrialization can swing.

A second and equally essential outside force leading to industrialization is the ability of the region to innovate. The industrialization of a region popularly con-

notes the establishment of competitive industries. It is believed that the region should have such a comparative advantage that industries will develop in the face of competition with older established firms. This, however, is not the usual pattern of industrialization. In most instances of regional economic expansion, the newly locating industries are new ones, such as was the case with the railroad equipment industry in the East, the automobile industry in the Midwest, and the airplane industry in the West. As technology changes, new regions, finding it difficult to compete with older ones with respect to well-established industries, are frequently quite receptive to the attendant innovations. Older regions, dependent upon established industries with their conventional patterns of production, subcontracting industries, credit, and marketing, tend to become somewhat rigid, and new concepts that do not conform with familiar ways may, therefore, be rejected. Attention, therefore, may possibly have been diverted in the assessment of economic expansion in the Pacific Northwest. The types of industry that are expected to develop may never appear. If industrialization occurs, it may well be spearheaded by industries that at present are in experimental stages. Such industries will grow and develop their own supporting industries in the process. What form they will take is impossible to predict.

Even if the possibility of industrial development based upon essentially new types of industry is granted, however, will it not occur with or without river basin development? Cannot innovations emerge which are independent of electric power as well as of the existence of supporting industries? When well-established modes of analysis are forsaken and reliance placed on speculation, anything is possible. No resources are so indispensable to development that development cannot possibly occur without them. Experience teaches us, however, to be cautious about economic projections. Arnold Toynbee warns that although the greater the challenge, the greater the response, there are cases where the challenge may be too great.[31]

For several reasons, therefore, river basin development will increase the possibility of industrial expansion. In the first place, it usually provides more agricultural land, which, as has been seen above, still plays a significant role in economic expansion. Second, the greater the amount of resources that are made available, the greater will be the probability of economic expansion which directly or indirectly utilizes one or more of them as a vital raw material. The fact that abundant electricity led to the location of the Hanford and Arco atomic plants in the first instance may lead to the location in those regions of industries utilizing atomic energy or its by-products.

In conclusion, it may be stated that except for the economic expansion surrounding agriculture, very little is known about the type or the degree of economic expansion which will be induced by river basin development and the types of resources made available by it. It seems quite certain that industries that require cheap and abundant electricity will locate in the region. Beyond that, however, nothing is certain, except that the probabilities of industrial growth are enhanced. What effects such probable growth will have on the national economy will now be discussed.

[31] 2 ARNOLD J. TOYNBEE, A STUDY OF HISTORY 274 *et seq.* (1934).

III

THE UTILITY OF ECONOMIC EXPANSION

In most treatises, it is assumed that economic expansion is advantageous to the economy as a whole. Classical economic theory set out to prove, through the law of comparative costs, that industry would always become so distributed that trade between regions, as between countries, would be to the advantage of all trading areas. More commodities would be available than would be the case if trade were restricted, and a day's labor would inevitably exchange for more goods and services. Since, by definition, an economy affording its members more goods and services than another economy is a better economy, trade must inevitably lead to better economic conditions or to higher national social value.[32]

More recently, however, doubt has been expressed as to the net social gain derived from all trade. The argument proceeds that trade between areas leading to the exchange of complementary goods is beneficial, whereas trade between areas leading to the exchange of goods that are competitive is not.[33] Complementary goods are commodities whose acquisition increases the utility of goods already possessed. For example, the acquisition of gasoline increases the utility of motor cars, the acquisition of cheap aluminum increases the utility of all products using aluminum. A competitive commodity, on the other hand, is one that acts as a substitute for another and, consequently, lowers the utility of the other commodity. Nylon, for example, lowered the utility of silk. The critical question, however, is whether or not the utility derived from securing a good substitute for silk was greater than the loss in utility of silk itself. If it was, there was a net social gain through the acquisition of nylon. The problem may be analyzed more effectively, then, by studying the effect of trade on the marginal efficiency of capital, rather than on the utility of the final product to consumers. If trade increases the value of capital goods and, consequently, induces greater investment, it is complementary. If, on the other hand, net investment decreases, such trade is competitive.

Without expounding further on their theoretical implications, these concepts may be applied to river basin development to determine the extent to which it adds to or detracts from the capital value of the national economy. This analysis is important for political reasons, for it is obvious that where public investment is required to develop river basins, such investment will enlist considerable political support if these developments will induce a considerable expansion in investments in older established areas; if, however, these developments will occasion a decrease in investments in older established areas, such investment will arouse much opposition.

With the exception of power developments, the initial impact of river basin de-

[32] For a complete analysis of the measurement of the benefits of increasing trade, see JACOB VINER, STUDIES IN THE THEORY OF INTERNATIONAL TRADE c. 9 (1937).

[33] See JACOB VINER, THE CUSTOMS UNION ISSUE (1950); Smithies, *European Unification and the Dollar Problem*, 64 Q. J. ECON. 159 (1950); Meade, *The Removal of Trade Barriers: the Regional Versus the Universal Approach*, 18 ECONOMICA (n.s.) 184 (1951); Meyer, *Complementarity and the Lowering of Tariffs*, 46 AM. ECON. REV. 323 (1956).

velopment is to create competitive rather than complementary trade. Greater productivity of agricultural lands and the development of irrigation projects increase the production of food products which enter into national trade in competition with producing areas in other regions. The effect will, therefore, be to lower land values in these older areas and to decrease the utility of food products already produced there. Again, the cheap labor and favorable location of the Tennessee River Valley encouraged certain types of industries to move from the older established areas to the South, and, here, too, the effect was competitive, rather than complementary. In the Pacific Northwest, on the other hand, the development of electroprocess basic reduction plants, especially of aluminum, and the failure of metal products industries to develop resulted in an increase in investment of considerable magnitude in plants using aluminum in the Midwest and the East. Developments of this nature are truly complementary, and the East could well encourage future investments of this nature, since the immediate effect would be to increase the marginal efficiency of eastern capital.

The longer the period of time which elapses after economic expansion has commenced, however, the greater appears to be the tendency for all trade to become complementary. National industries which develop in a new area tend to be complementary from the outset; whereas competitive industries, such as agriculture, tend more and more to become market-oriented and to supply the needs of the local population.

Several tentative conclusions, therefore, can be submitted regarding the social utility derived from river basin development, as reflected in trade between the newly developed region and the nation at large.

1. The wider the variety of resources made available to private exploitation, the greater is the probability that economic expansion will reach advanced stages of industrialization and maturity.

2. Power resources tend to develop industries that are complementary rather than competitive to the economy as a whole, but power resources have little ability alone to induce economic expansion.

3. Agricultural developments have relatively strong growth-inducement potential, but they tend, in the early stages at least, to lead to competitive trade relationships with the rest of the country.

4. Regions that are in close proximity to highly industrialized areas and to mass markets will experience industrialization more rapidly than more remote regions, but their industrialization most likely will be competitive in the early stages of economic expansion.

5. Remote regions will tend to develop more slowly, but the type of economic expansion that they will experience will lead to trade that is complementary throughout.

6. All regions, regardless of their degree of competitiveness in the early stages of trade and economic expansion, will ultimately become complementary.[34]

[34] Meyer, *supra* note 33, at 333.

THE SOCIAL CONSEQUENCES OF RIVER BASIN DEVELOPMENT

CARL F. KRAENZEL*

I

INTRODUCTION

Why is the United States concerned with river basin development? Does it need greater industrial and agricultural production than is potentially in prospect? This is hardly the case, except, perhaps, taking an extremely long-range view. Does it face difficulty in supplying the necessary livelihood for its anticipated population for the next quarter of a century? This, too, is inconceivable. Does it need more urbanization and a greater concentration of its population? This, also, is insupportable, although a case can, perhaps, be made that too many of our cities and too much of our urban population are located in too circumscribed a part of the nation for its fullest and most balanced over-all development.

The nation's concern with river basin development, it is submitted, is rather largely socially motivated, stemming from a desire to provide a more equitable and favorable economic and social climate for all of its citizens. For, it has been recognized that such development is an effective instrument for the conservation of resources, human and otherwise. It affords the controls needed to keep water, soil, and vegetation in place and at a high level of production, so that Americans of today and tomorrow will continue to enjoy an increasingly rising standard of living. It gives greater assurance of maximum utilization of power, irrigation, and other natural resource potential. And, perhaps most significantly, it imports a change in social values, emphasizing not only the natural-resource-conservation and individual-well-being points of view, but also the need for creating a greater, more pervasive social responsibility, extending over increasingly larger geographic areas and encompassing rural-urban differences and hinterland-metropolitan interdependence.

River basin development, thus, has been undertaken to bring the productivity of some underdeveloped areas in the nation more nearly into line with that of their more highly developed neighbors. Owing to the multifaceted character of river basin development, it has been possible to arrest progressive deterioration of resources—*e.g.*, erosion and flooding—and to encourage new economic opportunities—*e.g.*, hydroelectric power, irrigation agriculture, industrial expansion, new resource utilization, and recreation—with the result that income and employment have been increased

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and stabilized in areas that previously had been underdeveloped or had actually retrogressed and become nearly static. This emphasis upon the more balanced development of all the parts of the nation, moreover, has, to some extent, probably also arrested the appearance of slum areas, discouraged unnecessary population migration with its accompanying problems, and thus further contributed to the total welfare of the nation. Again, the major social consequence of this has been a change in value judgments, a strengthened belief in man's ability to manipulate his environment to improve his living standard.

Above all, then, it would appear that river basin development in the United States is symbolic of greater social justice, greater opportunity for individual self-development and realization, both economically and socially, everywhere in the nation, but particularly in disadvantaged areas. Viewed somewhat differently, river basin development is aimed at curbing the exploitation of one area by another and at introducing a greater measure of economic and social, as well as political, democracy than now prevails in the nation.

In order fully to appreciate the social role of river basin development, it is necessary to understand that the United States has become a highly urbanized, commercial-industrial society. This means that a few metropolitan centers tend to dominate and appropriate other urban centers and all the land, resources, and population of the nation. Bogue has demonstrated that there are only sixty-seven such metropolitan centers of dominance in the United States and that this is simply part of a historical evolutionary process in the course of which an ever-larger hinterland is tied to the center.[1] Gras, too, recognized this process;[2] and McKenzie described it in great detail.[3] Bogue, however, has refined the idea more specifically by showing that not all large cities are metropolitan in character, in the sense that they dominate, and that some larger centers are as subservient to the dominant city as many smaller communities and the purely rural or agricultural resource areas.[4]

The social significance of this phenomenon is that the dominance of metropolitan centers over the hinterland area is largely a one-way, metropolitan-to-hinterland, communication avenue and that it has been a random, accidental, unplanned process, one that has come to encompass increasingly more territory, people, and other larger centers. In this process, there has been an expansion of metropolitan influence and activity beyond local city, county, and even state borders and an appropriation of

[1] DON J. BOGUE, THE STRUCTURE OF THE METROPOLITAN COMMUNITY, A STUDY OF DOMINANCE AND SUBORDINANCE especially 16 *et seq.* (1950).

[2] Gras traced the relation of the hinterland to the center through the following stages: (1) the collection economy, (2) the cultural nomadic economy, (3) the settled village economy, (4) the town economy, and (5) the metropolitan economy. Although each stage has increasingly released man from dependence upon the local economy, it has made him progressively more dependent upon an ever-widening area. N. S. B. GRAS, AN INTRODUCTION TO ECONOMIC HISTORY (1922).

[3] McKenzie, applying the ecological approach to urban phenomena, described the specialization and interdependence of cities and the interrelationship of their parts into an integrated whole and ascribed to this complex the idea of a supercommunity. R. D. MCKENZIE, THE METROPOLITAN COMMUNITY (1933).

[4] BOGUE, *op. cit. supra* note 1, especially cc. 2-9.

resources and people, all without benefit of democratic participation on the part of the residents of the hinterland. For, other than metropolitan-area planning districts and interstate compacts, there is now no truly democratic political device whereby the residents of the hinterland, and even large segments of the metropolitan residents, can participate in the decision-making that would make of such an area a community, or at least a cohesive political unit. This failing is a serious affront to democratic institutions and to the spirit of democracy itself.

Whatever else the need in the United States, therefore, a compelling task for the future is the curbing of this exploitation of the hinterland by the metropolitan center. This requires the introduction of a mechanism for insuring the democratic participation in decision-making by all the people, whether they live in or near the center or in the far hinterland of the metropolitan areas that comprise the total urbanized, commercial-industrial society of the nation.[5] And basin development, because of its success in the Tennessee River Valley and because of the absence of other satisfactory models, is the pattern that is generally proposed in the United States for the initiation and the fulfillment of this task.

Before evaluation of river basin development in this context is attempted, however, the following classification of social consequences is indicated:

1. those involving people as individuals and in group relationships on a more-or-less local level; and

2. those involving a larger area of interaction, the ever-widening area of economic and social intercourse beyond the boundaries of traditional local government, the more nearly regional level.

And two specific types of situations that must be analyzed, with respect to these social consequences, are:

1. those wherein the river basins have within or close to their confines existing metropolitan centers, including metropolitan centers of dominance, such as the Tennessee River Valley;[6] and

2. those wherein the river basins do not have within or close to their confines existing metropolitan centers, including metropolitan centers of dominance, such as the Missouri River Valley.[7]

It is the purpose of this paper to show, by focusing on the Tennessee and Missouri

[5] See R. E. DICKINSON, CITY REGIONS AND REGIONALISM especially 3, 4, 6, 105-07, 245-46, 249-53, and c. 9 (1947). See also HOWARD W. ODUM AND H. E. MOORE, AMERICAN REGIONALISM especially 3-5, 9-13, 143-50 (1938); Davidson, *Political Economy of Regionalism*, 6 AM. REV. 410, 430-32 (1936); Brocard, *Regional Economy and Economic Regionalism*, 162 ANNALS 81 (1932); Davidson, *Political Regionalism and Administrative Regionalism*, 207 *id.* at 138 (1940).

[6] A study of the metropolitan facts and the location of basins would indicate that other river valleys most like that of the Tennessee are: the Ohio; the Potomac; the Alabama-Coosa; the Connecticut; the Central Valley of California; the St. Lawrence; the Mississippi, as a whole or segmented into the upper and the lower; and certain others. For more extensive details, see 2 PRESIDENT'S WATER RESOURCES POLICY COMM'N, REPORT (1950).

[7] A study of the metropolitan facts and the location of basins would indicate that other river valleys most like that of the Missouri are: the Rio Grande; the Arkansas; the Red River of the South; the Brazos; the Columbia; the Colorado; and certain others. For more extensive details, see *ibid.*

River Valley situations, that the nature and the magnitude of the social consequences of river basin development necessarily depend on the peculiar context in which the development transpires. From this, there follows the corollary that where river basins have no metropolitan centers within or close to their confines, their development will not necessarily result in increased social justice and democratic participation—it may, indeed, exacerbate existing patterns of exploitation—unless accompanied by true regionalism.[8] Such, in fact, may also be true of situations in which the river basins have metropolitan centers within or close to their confines;[9] but failure to achieve social justice and democratic participation there would be attributable to reasons other than the absence of an indigenous metropolitan influence.

II

THE TENNESSEE RIVER VALLEY

The TVA has become world-renowned as a model of integrated and coordinated development on a river basin level. Greater economic opportunity and social justice have come to the residents of the Tennessee River Valley with the initiation of the program;[10] and the advances have not been confined to material spheres alone, but have extended as well to leadership development, community enrichment, and intercommunity and interagency cooperation.[11]

Actually, the development of the Tennessee River Valley has occurred on three geographic levels and demonstrates how ramifications from a center of activity may encompass adjacent areas. First, there is the valley proper, containing three and one-half million people, spread out over 40,910 square miles, resulting in an average density of eighty-five persons per square mile, as compared with an average density of fifty-one persons per square mile for the entire nation. Next, there is an area twice as large, containing six million persons, served by TVA-generated electricity, distributed through municipally-owned or rural cooperative systems and some large

[8] By regionalism, the writer does not mean metropolitan planning areas, nor interstate compacts or interagency committee organizations, nor a valley-authority type of region, but rather a distinctly new type of social organization through which the people of areas larger than a state, or portions of several states, or a city and the surrounding rural area can participate democratically, politically and financially, in the necessary area development. It is not provincialism, nor is it the separatism of the past. It stresses cooperation among the several political units in the region and between the regions. It does not need boundaries, except for general identification, but it requires a central organization for the area involved where decisions can be made, the execution of which can be assigned to the existing county, state, town, and city political units. For a more detailed analysis of this concept of regionalism, see CARL F. KRAENZEL, THE GREAT PLAINS IN TRANSITION cc. 25 and 26 (1955).

[9] This qualification is introduced because the writer feels that, eventually, river basin development will prove inadequate to the task of introducing and maintaining social justice and democracy in metropolitan-hinterland relations even in the small basins which already have indigenous metropolitan centers. For a time, of course, river basin development alone may relieve the tensions, but here, too, the new device of regionalism must inevitably prevail.

[10] For an exhaustive enumeration of the more tangible accomplishments of TVA—engineering, industrial, and economic—see "Progress in the Tennessee Valley (1933-52)," *Hearings before the Subcommittee to Study Civil Works of the House Commitee on Public Works*, 82 Cong., 2d Sess. (1952).

[11] This is symbolized by the titles of revealing books by two well-known former TVA board chairmen. DAVID E. LILIENTHAL, TVA, DEMOCRACY ON THE MARCH (1944); GORDON R. CLAPP, THE TVA, AN APPROACH TO THE DEVELOPMENT OF A REGION (1955).

industrial users. The third area includes all of the seven states—Tennessee, Alabama, North Carolina, Virginia, Georgia, Kentucky, and Mississippi—which, by virtue of having all or part of their territory within the drainage basin of the Tennessee River, have felt the impact of its development in varied degree.[12]

Within this last-mentioned seven-state area are to be found twenty-six of the nation's 168 standard metropolitan areas, as defined by the Census,[13] with an aggregate population of about six and one-half million. This would indicate that these metropolitan centers are among the smaller ones in the nation; yet, certain other large metropolitan centers are nearby. Nine of the sixty-seven metropolitan centers of dominance, as defined by Bogue, are within the basin states.[14] Three of them, all in Tennessee, are within the basin proper—Chattanooga and Knoxville on the Tennessee River itself, and Nashville on a tributary, the Cumberland River; the other six are Louisville, Kentucky, Atlanta, Georgia, Birmingham, Alabama, Richmond, Virginia, Charlotte, North Carolina, and Memphis, Tennesseee. In addition, such other cities as Cincinnati, Ohio, and Evansville, Indiana, are not without influence in the Tennessee River Valley area. The basin, therefore, has had ready access to metropolitan forces and resources in aid of its development.

Most significantly, however, the Tennessee River Valley is located in the humid part of the nation, and it is this basic resource and climatological fact, along with urbanization, industrialization, and metropolitanism, that forms the dominant core of the spirit of economic and social development in the United States.[15]

The items enumerated in Table I describe the kinds of social consequence that appear to have accompanied basin development in the Tennessee River Valley and, to a varying degree, in the several states in which the influence of this development has been felt. A more detailed description of each item would be cumbersome at this point and can, moreover, readily be obtained elsewhere in the literature. But from even this cursory catalogue, it is clear that expansion of economic and social opportunities has ranged from improved initiative and choices for individuals, through awakened local community action of all degrees, to functional cooperation among states and between state and federal agencies. Nor can there be any doubt that the resultant social change has been extensive, as is readily apparent from the details of the case-history analyses of situations for persons, communities, institutions, towns, and agencies in the area. There have been pro and con views on many issues raised, of course, but compromise solutions have generally been achieved, owing to an increased measure of cooperation among groups and interests that would otherwise have conflicted or functioned in isolation. There have also been problems that have flowed from this closer association of people, such as is being evinced by the present antidesegregation struggle in Clinton, Tennessee. All this was to have been expected.

[12] See JAMES DAHIR, REGION BUILDING 13 (1955).

[13] 2 U. S. BUREAU OF THE CENSUS, DEP'T OF COMMERCE, CENSUS OF POPULATION: 1950, pt. 1, c. C, at 27-31, and Table 27, *id.* at 1-72-1-73 (1953).

[14] BOGUE, *op. cit. supra* note 1, at 16-17.

[15] For a fundamental contrast between this humid, forest-land situation, on the one hand, and the semiarid, treeless Great Plains, on the other hand, see WALTER PRESCOTT WEBB, THE GREAT PLAINS (1931).

TABLE I—AREA OF ACTION INVOLVING SOCIAL CONSEQUENCES IN WHICH BASIN DEVELOPMENT IN THE TENNESSEE RIVER VALLEY HAS MADE A SIGNIFICANT CONTRIBUTION*

1. For the individual, increased opportunities for advancement in educational, occupational, living standards, and social participation matters, including the extension of such opportunities to all economic levels, regardless of race (*i.e.*, including Negroes).

2. To actually motivate individuals and groups, an enhanced psychology of optimism, with reasonable assurance that these things would come to pass.

3. To assist individuals and groups, the development of leadership on a local level, such as extension agents, agency workers, teachers, farmers, and businessmen on all levels. This was done by involving these people in the actual participation of the program, with a training program for leadership development, if necessary.

4. For community development, the involvement of local people on a community and intercommunity level, with leadership, technical, and financial assistance from outside, if necessary.

5. For institutional development and expansion, the involvement of local agencies and institutions, such as the library extension program, the improvement and consolidation of schools and churches, the promotion of public health services, and the introduction and extension of cooperative enterprises, such as rural electrification associations.

6. For coordination and cooperation among like and different institutions and agencies, the involvement of these into larger-than-traditional areas of operation, including the involvement of counties across state boundaries.

7. For town building, the encouragement of businessmen to introduce new businesses or extend and improve existing services, even to the extent of giving a new look by facelifting of the main streets.

8. For pride and self-esteem, a reforestation and beautification program for homesteads, town sites, recreation sites, and farm and field appearances. In addition to providing new employment, economies, and efficiencies, this built a morale that was supported by public consensus and encouraged others to conform.

9. For better understanding and a larger view, research and planning information carried on, often with local help and encouragement, resulting in a more effective incorporation of this new knowledge into the operations of the program.

Certain major conclusions concerning the social consequences of basin development seem to be inferrable from the Tennessee River Valley experience:

1. Improvement of individual welfare, community organization, institutional growth and coordination between functions and between areas can come about most easily and with greater chances of success when there is help from outside—from outside the individual and from outside the area.

2. Such outside help is most productive if it is based on knowledge and understanding that research and planning can provide.

3. This help and knowledge is most productive if it is made available on the "grass-roots" level, so that people, communities, and agencies can husband these things to themselves as their own.

* This classification is one drawn up by the writer in an attempt to inventory and summarize the kind of sociological phenomena, action, and consequence that occurred in the Tennessee River Valley, not solely because of basin development, but certainly with its encouragement. This classification, although distilled from many publications, does not purport to be exhaustive.

These are fundamental social-action principles that have been clearly identified and recommended for any action program. They have unequivocally been recognized, encouraged, and successfully applied by the TVA administration. The end product, as social consequences, could, therefore, not help but be constructive and beneficial.

But there must be a final warning. How much of this success in achieving desirable social consequences is attributable primarily to river basin development, and how much to other factors? As has been indicated, the TVA area does contain metropolitan centers and is close to others—spatially, economically, industrially, and socially. It always has been, and still is, more nearly a part of the urban-industrial-technological complex than of the area that has been dispossessed and discriminated against by the metropolitan concentration typical of American society today. It is a part of the American interior, behind the first range of mountains, that forms the base of an America prepared for war or peace—and so is in a state of optimistic expansion. Thus, it is clear that integrated development of the Tennessee River Valley, now past the quarter-century mark, transpired in optimal surroundings.

On the other hand, however, it is also apparent that development of the Tennessee River Valley provided much outside leadership and aid to individuals and communities in their efforts to achieve a fuller self-realization. Nor can there be doubt that the policy aims and leadership of the TVA administration were "socially aware" and "democratically" inclined; nor that this leadership deliberately experimented with the available tools and knowledge.[16] Consequently, although factors other than river basin development may have been instrumental in effecting the favorable end result, this should not detract from the TVA experiment and the magnitude of its contribution in this regard.

That the TVA's success in achieving desirable social consequences can be duplicated in other river basins similarly favored by the presence of the peculiar urban, industrial, and technological structure typical of metropolitan dominance and concentration is a highly probable fact. That such consequences will follow in river basins that are without or denuded of such urban, industrial, and technological structure, however, is still to be determined. The testing ground is likely to be the Missouri River basin.

III

THE MISSOURI RIVER VALLEY

The Missouri River Valley contains 530,000 square miles, thirteen times that of the Tennessee River. The longest straight-line distance spanning the basin is 1500 miles. Much the larger part of it is of arid or semiarid mountain or plains topography and climate, and only the eastern part, east of the ninety-eighth meridian, is subhumid or humid, more nearly like the Tennessee River Valley's climatic conditions.[17]

[16] See generally LILIENTHAL, *op. cit. supra* note 11; CLAPP, *op. cit. supra* note 11.

[17] See MISSOURI BASIN SURVEY COMM'N, MISSOURI: LAND AND WATER (1953); Ickes, *Missouri River Basin*, S. Doc. No. 191, 78th Cong., 2d Sess. (1944). See also 2 PRESIDENT'S WATER RESOURCES POLICY COMM'N, *op. cit. supra* note 6.

Whatever other contrasts may be drawn between the Tennessee and the Missouri River Valleys, however, two stand out graphically. The first is the industrial underdevelopment and arrest of population growth in the upper Missouri River Valley, occasioned by the absence of indigenous urban, industrial, and metropolitan influences, which are concentrated rather in the southern and easternmost (and most humid) parts of the basin or impinge on the basin from the outside. The second major contrast between the Tennessee and Missouri River Valleys is the lack of adapted institutional and cultural traits and patterns in the Missouri River Valley except, perhaps, for some of the ways of agriculture. The way of life in the upper Missouri River Valley, west of the ninety-eighth meridian, is an insecure one, because it has been shaped by a nonobjective, humid-area bias and, accordingly, is not suited to the conditions of semiaridity that prevail there.[18] Agriculture, in parts of the basin, has made certain suitable adaptations, but owing to the lack of urban-metropolitan complexes that are properly oriented to and might be foci for such development, there has been only limited dissemination of even such practices. Furthermore, there has been virtually no similar adaptation of the remaining political, financial, business, economic, and social institutional structure. And this vitally affects the lives of all the residents, the farmers and ranchers included.

More detailed reference, perhaps, should be made to the lack of metropolitan influences in this area. Eighteen of the total of 168 standard metropolitan areas, as defined by the Census, are located within the borders of the ten states that are wholly or partially drained by the Missouri River system, although only seven of these centers are in the basin proper.[19] Of these seven, moreover, only one—Denver, Colorado—is located in the semiarid portion of the basin, the mountainous southwestern part; the six others—Sioux Falls, South Dakota, Lincoln and Omaha, Nebraska, Sioux City, Iowa, and Kansas City and St. Joseph, Missouri—are located in the humid eastern portion. Thus, all seven of the metropolitan areas in the basin proper are located on its periphery. The eleven remaining metropolitan centers in the above-mentioned ten-state area—Pueblo, Colorado, Topeka and Wichita, Kansas, Davenport (including also Rock Island-Moline, Illinois), Cedar Rapids, Des Moines, and Waterloo, Iowa, St. Louis and Springfield, Missouri, and Minneapolis (St. Paul) and Duluth, Minnesota—are also located chiefly in the humid eastern states. Three states—Montana, Wyoming, and North Dakota—have no metropolitan areas at all.

Of the sixty-seven metropolitan areas of dominance, as defined by Bogue, nine are within the borders of the basin states.[20] Three of them are within the basin proper—Denver, Colorado, Kansas City, Missouri, and Omaha, Nebraska. Denver is at the breaking point of transportation over the Rocky Mountains, however, and it serves the nation, in a national sense, perhaps even more than it serves the mountain area and the Missouri River Valley; thus, it is not a truly indigenous Missouri River

[18] For a more extended discussion of this feature, with reference to not only the Missouri River basin, but all of the Great Plains, see KRAENZEL, *op. cit. supra* note 8.

[19] U. S. BUREAU OF THE CENSUS, *loc. cit. supra* note 13.

[20] BOGUE, *op. cit. supra* note 1, at 16-17.

Valley city. And the humid-area orientation of Kansas City and Omaha makes of them less indigenous cities than is required if they are to function truly in the setting of the Missouri River Valley. Much the same can be said of the remaining six metropolitan centers outside the basin proper, but within the borders of the basin states—as a simple enumeration and visualization of their locations will make clear: St. Louis, Missouri, Minneapolis (St. Paul), Minnesota, Des Moines, Iowa, Wichita, Kansas, Duluth, Minnesota, and Davenport (Moline and Rock Island, Illinois), Iowa.

It would seem to be clear, therefore, that the Missouri River Valley is largely denuded of the urban, industrial, and metropolitan functions that would make it vitally competitive with other areas of the nation. Significant also is the fact that its existing metropolitan centers, as well as those that impinge on the basin from outside, are operating in the context of a humid-area psychology and social value system which they project upon a semiarid or arid land. Furthermore, these centers are in the shadow of a still larger complex of metropolitanism (Chicago-Philadelphia-New York City) to which they are necessarily affiliated.

Coupled with the nonindigenous fact of the metropolitan centers that serve the upper Missouri River basin is the already-noted lack of institutional and cultural adaptations or lack of suitability of the ways of living that are projected upon the upper Missouri River basin population, especially that portion to the west of the ninety-eighth meridian. To have successful institutional and cultural adaptations in the basin, there must be a reshaping of humid-area patterns to conditions of semiaridity, or invention and dissemination of new patterns that are alternatives to the imperfect and imported kinds.[21] To achieve this, however, it is necessary to undertake basic research and to assume a scientific objectivity that would free the mind from humid-area bias. It is necessary, also, both to develop resources, facilities, leadership, and manpower to aid the process, and to foster an inviting climate of university atmosphere and an urban-metropolitan consciousness that would be the focal point for tolerance and promotion of such ideas.

These factors emphasize the need for true regionalism, in the widest sense.[22] For, in the upper Missouri River Valley, there are obviously not enough resources and people to effect its full development, especially without indigenous cities. Other basins in the Great Plains are faced with the same problem—among them, the Rio Grande, the Brazos River, the Red River of the South, and the Arkansas River. This problem, then, broadly becomes one of Great Plains, not merely Missouri River

[21] For example, to have institutional stability in the area, it is necessary to have reserves, accumulated in good years, for use in years of no income. This is as true for schools, churches, towns, county and state government, business enterprises of all kinds, and all other institutions as for individuals, family living, and farm and ranch operating costs. Yet, the humid-area patterns of financing, federal taxation, banking, price-making forces, etc., do not recognize this fact. Even the present federal program of price support and production control for Great Plains wheat farmers violates, to the highest degree possible, this essential principle, the need for accumulating reserves for successful living in the area. There are numerous other basic adaptations that are also necessary—some already partially instituted, others still to be tested, and many yet to be devised, and they, too, must widely be disseminated and ingrained into the way of life.

[22] See KRAENZEL, *op. cit. supra* note 8, cc. 25, 26, and 27.

Valley, significance. From this, it follows that basin development of the Missouri River may be a proper tool, but only if it is conceived as but one element of a larger over-all scheme of regionalism that is Great Plains-wide in scope. Only in this context will the social consequences of basin development be fully constructive and basically significant in the Missouri River Valley. This requires further elaboration.

A detailed study of the geography of the Missouri River Valley reveals the following aspects: The Missouri River originates in a clearly defined geographic region, the Rocky Mountains of the northern United States. After it and its major tributaries (the Yellowstone River, the Platte River, and others) leave the Rockies, they traverse the northern Great Plains, often in a northerly, then in an easterly, and finally in a southerly direction. Eventually the Missouri River itself and some of its lower tributaries enter into a third region, namely, the subhumid and humid Mississippi River Valley to the east.[23] Measured in terms of the distribution of population, cities, newspapers, universities and colleges, and most other processes that affect the lives of people, the balance of the scale of values in the Missouri River Valley, too, is tipped decidedly downstream, in the humid-area direction. The lower basin, then, east from the ninety-eighth meridian, is like a funnel into which the entire upper basin is filtered and drained, and with respect to which the upper basin operates in hinterland fashion.[24]

Although ample factual evidence to support this conclusion can be marshalled, only two specific items will be mentioned. The so-called Missouri Compromise of 1944 stipulated that the waters of the Missouri and its tributaries, west of the ninety-eighth meridian, should be used first for irrigation upstream, in the mountain and plains area, and secondarily, or later only, for downstream uses—urban and industrial water supply and navigation.[25] Although this scheme was ratified by Congress in 1944, in June 1956, the matter, in a related way, was again raised in the form of the Barrett bill,[26] which was approved by the Subcommittee on Irrigation of the Senate Committee on Interior and Insular Affairs.[27] Whether the Missouri Compromise of 1944 will withstand the tests of downstream pressure and still be enforced is still to be decided. The history of Missouri Compromises in the past, however, has not been reassuring.

Still another inroad—albeit largely unpublicized—has recently been made into

[23] See 2 PRESIDENT'S WATER RESOURCES POLICY COMM'N, *op. cit. supra* note 6, at 165. The Missouri River basin proper is divided into several subareas—namely, the Rocky Mountains, the Northern Ranching Area, the Great Plains, the Black Hills, the Sand Hills, the Flint Hills, the Ozark Highlands, and the Lower Missouri Flood Plains. This does not include the areas in the ten states that are not within the basin proper.

[24] There are some writers, including geographers, who deride the "hinterland" concept. Frequently residents of metropolitan centers and larger universities, they have never truly experienced the helplessness of the people who function in a hinterland role; or else they are biased against old and established facts that are not couched in current scientific language.

[25] Flood Control Act of 1944, 58 STAT. 889, 33 U. S. C. § 701-1(b) (1952). See also MISSOURI BASIN SURVEY COMM'N, *op. cit. supra* note 17, at 159, 198.

[26] S. 863, 84th Cong., 2d Sess. (1956).

[27] S. REP. No. 2587, 84th Cong., 2d Sess. (1956). See also Western Water News, June 1956, pp. 4, 5.

the principle of the Missouri Compromise of 1944. The years 1953-54 were dry ones in the upper Mississippi River Valley—so dry that the streamflow level could not keep the salt waters of the Gulf of Mexico from threatening the water supply of New Orleans. To remedy this situation, the Army Engineers lowered the storage water level in Fort Peck Reservoir in Montana from seventeen and one-half million acre-feet to five or six million acre-feet, or by about seventy per cent. This accumulation of water in Fort Peck Reservoir had been intended to fill a large part of Garrison Reservoir in central North Dakota, following its completion. Now, with a drought in prospect in the northern Great Plains and Rockies, irrigation water is at a minimum—because of pressure from downstream interests, not on the Missouri River, but at the mouth of the Mississippi River.[28]

But the issue is not even that simple. The upper Missouri River Valley is the hinterland of the so-called Twin Cities, Minneapolis and St. Paul, Minnesota, generally described as "the Northwest." It is the major revenue area for a number of railroads, among them the Great Northern, the Milwaukee, the Northern Pacific, the Burlington, and, to some extent, the Union Pacific—all leading into the Twin Cities and/or Chicago. Navigation on the Missouri River, as a facet of multipurpose river basin development, would reroute some of the payload to Kansas City and St. Louis, Missouri, and ocean-wise. So there is rivalry not only in the Missouri River Valley, but outside it, between metropolitan centers in the humid area for tribute from the upper basin. This affects some of the major economic and institutional complexes of the economy, among them wholesaling, financing, newspaper circulation, marketing, interest-taking, market manipulation, price-making and fixing, convention gathering, and governmental agency and service headquarters.

What has been said of the Missouri River Valley is equally true of the remaining Great Plains rivers, different in degree only—the Rio Grande, the Brazos River, the Red River of the South, and the Arkansas River. They all rise in the mountains, traverse the semiarid Great Plains, and empty into the humid-area portions of the states involved or into adjacent humid-area states. Thus, in Texas, a major struggle can be witnessed between the semiarid or arid and the more humid parts of that state for scarce water that is insufficient for the agricultural and the urban-industrial development that has flourished there in recent years.[29] In some instances, international aspects are also involved—with Mexico, in the case of the Rio Grande; with Canada, in the case of the Red River of the North and the Belly River, a subsidiary of the Milk River which empties into the Missouri River.

And the western tier of Great Plains states—Montana, Wyoming, and Colorado particularly—are likewise drawn downstream, all the way to the Pacific, where the larger urban and industrial complexes in the Columbia River and the Colorado River basins are located. The downstream pull in these basins is gigantic, as is evidenced

[28] See *Will Water Become Scarce?* (an interview with Lt. Gen. Samuel D. Sturgis, Jr., Chief of Engineers, United States Army), U. S. News & World Report, April 27, 1956, p. 85.

[29] For the details of this conflict, see WALTER PRESCOTT WEBB, MORE WATER FOR TEXAS (1954).

by overappropriation all along the Colorado River[30] and the proposed diversion of some of the waters of the Columbia River southward, all the way to California.[31] The situation on the Colorado River has been further intensified by the construction of the Thompson tunnel in the Colorado Rockies to divert some of the water flowing westward into the Great Plains for irrigation and for urban use.[32] Here, too, are international complications. The prospects are real that a great industrial and urban expansion in British Columbia will indicate the hoarding and diversion of the headwaters of the Columbia River before it enters the United States. Such waters, at the Canadian source, could readily be diverted into the Fraser River, with great benefit to Canada.

Without delving further into the details of the industrial, economic, political, legal, and governmental aspects involved, it thus becomes apparent that river basin development could easily result in further exploitation of the people and resources of the upper Missouri River Valley by the existing urban-industrial complexes that have their foci in the lower basin or outside the area; and this is also the case with the other Great Plains rivers.[33] Empire building of an earlier period, accomplished by personal power and the strength of the boss on the job, has today become empire building of a more subtle type, with the aid of legal advice, public funds, manipulation of public opinion, and the help of the federal government. Where once Jim Hill built on his own, the government-business partnership deal in hydroelectric development now has recruited the taxpayers of the nation as shareholders in a venture to build private gains and power on a still larger scale.[34] Instead of hydroelectric development, hospital and medical care insurance might have been cited;[35] or flood control and navigation, as practiced by the Army Engineers, might have been used to illustrate the point.[36] And in the guise of national goals and objectives un-

[30] See 2 PRESIDENT'S WATER RESOURCES POLICY COMM'N, *op. cit. supra* note 6, at 355-56, 359, 361, 388-93, 395-96, 460-62.

[31] *Id.* at 142.

[32] *Id.* at 166, 184, 186, 201, 442, 445.

[33] The skeptic needs only to review the off-shore oil controversy after World War II, in which the "states' rights" issue was the blind for appropriation of the oil of the southern Great Plains by international business concerns. For more detailed discussion of the earlier part of this maneuver, see A. G. MEZERIK, THE PURSUIT OF PLENTY especially c. 5 (1950). The citizenry of the more isolated northern Great Plains, with its newly discovered oil prospects in Montana and the Dakotas, had not even become aware of its potential before they lost control of this resource. This story has yet to be written, and the records for it will not easily be found. Nor is the pattern greatly different for electric power and certain other resources of the Missouri River Valley.

[34] The struggle as to whether there shall be public or private power development at Hell's Canyon on the Snake River in the Columbia River basin is the more dramatic aspect of the larger struggle that is taking place in all the basins of the West, including that of the Missouri River, and in the basins of the East, as evidenced by the Dixon-Yates affair.

[35] Speaking of hospital and medical care insurance, it is obvious that most such private plans, limited to state-wide coverage as a rule, do not have sufficient enrolment and finances to accumulate the necessary reserves that are essential for building a financially sound program that can weather several years of low income induced by drought combined with other hazards common in the Missouri River basin and the Great Plains generally. No way has been worked out to protect the long-time contributor who suddenly finds himself without income to pay his premiums, his taxes, his operating costs, and his family living costs in such poor years. A federal subsidy to such programs is not facing the realities of the situation in the Missouri River basin and the Great Plains proper.

[36] See ARTHUR MAASS, MUDDY WATERS: THE ARMY ENGINEERS AND THE NATION'S RIVERS (1951).

suited to Missouri River Valley conditions, dryland ranching and farming are caused to meet head-on with irrigation farming, to make the contrast between humid-area and semiarid ways of life even more striking than ever.[37]

The solution to this dilemma lies in an appreciation of the fact that river basin development is but one of many techniques that may be employed to unite the people and resources of a region so that they may work out their destiny in cooperation with the other regions of the nation and with the aid of the nation itself. As a means to this end, river basin development would have one fundamental advantage: as a rule, river systems traverse or touch upon several regions, and their development, thus, would force upon people and interests, whether private or public, the recognition that some population-resource development can take place only on a regional level and by virtue of cooperation between several regions. River basin development, thus, would become a strategic tool for implementing cooperation between several regions. This is, perhaps, its strongest point.[38]

In further support of regionalism as the ultimate solution of the problems of the upper Missouri River Valley and the Great Plains as a whole, several other considerations should be kept in mind. For one thing, the states—especially Montana, Wyoming, Colorado, and New Mexico—now pulled in at least two directions by strong basin development, need to find a basis of unity. This is also true of the eastern tier of Missouri River Valley states—North and South Dakota, Nebraska, and Kansas—which are pulled Missouri River basin-ward for some of their interests and humid area-ward for other of their interests. So, too, with Oklahoma and Texas. It would appear that regionalism, conjoined with river basin development, would be best suited to assist in creating this necessary unity. Then, basin development could do its more limited job, regardless of the region the river system traverses.

The Missouri River Valley and the Great Plains, moreover, are generally inhabited by residents who think, and act, and live as minorities. This is because of lack of adequate transportation and communication within the area and because of lack of region-centered solutions of the basic difficulties in the area. This failing is compounded by the torn-apart allegiance of the residents to various centers and interests outside the region. These minority-group attitudes and modes of behavior are, in a measure, the expression of people who cannot resolve their problem situations and see little prospect of doing so. Their frustrations find release in striking out at other people and situations, at random, or in withdrawal behavior.[39] Basin develop-

[37] The arid regions of the nation (the Rocky Mountain and Intermountain West) have an oasis type of settlement. Agricultural people live in irrigated areas and use the surrounding land in conjunction with the irrigated base. But in the semiarid Great Plains, people live all over the land, including the dryland. Relatively speaking, irrigation development is insignificant in size and scope. Hence, irrigated farmers live next to areas where dryland farmers and ranchers live, and except where there is purposeful integration between dryland farming and ranching, on the one hand, and irrigation, on the other hand, there is a decided contrast between these two types of settlement. An increase in irrigation can only emphasize this contrast and distinction and the misunderstandings and problems that flow therefrom.

[38] See KRAENZEL, *op. cit. supra* note 8, cc. 26 and 27.

[39] For an analysis of this feature with respect to the Great Plains, see *id.*, cc. 17-20. Not only nationality and racial groups comprise these minorities; farmers, ranchers, businessmen, laborers, profes-

ment alone offers little prospect of remedying this minority-group psychology in the upper Missouri River Valley. In fact, the likelihood is that this characteristic will become more intensified as the people and interests of the different areas in the basin consequently come into more frequent and intimate contact, and as the differences between unintegrated dryland, on the one hand, and irrigation development, on the other, become more pronounced by virtue of this closer relationship. Only in the context of regionalism, with its attendant increased opportunity for effective participation in policy-making matters, can river basin development assist in resolving this minority-group conflict in the region.

Nor will basin development, without the aid of true regionalism, avoid the increased social cost of space in much of the upper Missouri River Valley that stems from the great distances and scattered habitation and the growing loss of population in many areas of the basin.[40] This problem cannot be met except with increased subsidy or by postponing services; and the latter alternative usually results in higher rehabilitation and relief costs at a later date. Accompanying this phenomenon of the increased social cost of space is the fact that the fewer residents who remain may have higher individual and personal incomes, but these higher incomes cannot necessarily support the basic institutions under conditions of overly sparse population. Associated also are other social facts, such as a psychology of resources exploitation, a philosophy of temporary residence, an excessive population mobility and loss, a general underdevelopment of the community,[41] and fewer social opportunities, so that people find it more difficult to achieve well-rounded experiences for effective leadership and personality development.[42] There is little that river basin development alone can do to resolve or mitigate these problems.

Finally, the inadequacy of river basin development as a solution of the problems of the Missouri River Valley is exacerbated by the unguided and uncoordinated nature of the existing program. The Inter-Agency Committee has no power to integrate the efforts of separate agencies;[43] it is not an official committee with authority truly to represent the residents of the area;[44] and it has no way of working with these residents. It has been said that "few local people have ever appeared on the committee's program, and an examination or the minutes indicates no local

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sional people, management groups, and others, too, band together and exhibit behavior that bears the stamp of a minority-group psychology of a basic and debilitating order. The Indian minority, which is sizable in the upper Missouri River basin, is extensively exploited by the other minorities of the basin, and such exploitation varies in intensity with the struggle for the advantages heralded by basin development. See *id.* at 72-90, 238-42. But, except for its more extreme aspects, the Indian minority role is not fundamentally different from that of the other minority groups in the basin. For a more detailed analysis of the Indian problem in the basin development of the Missouri River, see FRANCES CUSHMAN AND GORDON MCGREGOR, HARNESSING THE BIG MUDDY (1948).

[40] See KRAENZEL, *op. cit. supra* note 8, at 201-06.

[41] See CARL F. KRAENZEL, MONTANA'S POPULATION CHANGE, 1920 TO 1950 (1956), which contains data not only for Montana, but for states adjacent to it.

[42] See, *e.g.*, FRANK ALEXANDER AND CARL F. KRAENZEL, SOCIAL ORGANIZATION OF SWEET GRASS COUNTY, MONTANA (1953).

[43] See MISSOURI BASIN SURVEY COMM'N, *op. cit. supra* note 17, at 85-86.

[44] *Ibid.*

group or person has made protest before the Inter-Agency since June 1950."[45]

It is apparent, then, that there has not been the coordination among governmental units in the Missouri River Valley that there has been in the Tennessee River Valley. There has been neither the devoted leadership of a Lilienthal or a Clapp and others to make democracy work from the grass-roots level, nor the help from the outside to make communities grow—help in the form of guidance, leadership encouragement, organizational integration and coordination into larger areas of interaction, town-building for permanent living, research, and information-gathering and dissemination for the solution of local problems. And, above all, there has not been the development of a similar psychology of optimism and growth for individuals and groups in the region.

IV

CONCLUSION

A major hypothesis of this paper has been that the concentration of population in metropolitan areas that are also the foci of our peculiar urbanized, commercial-industrial economy has been increasing, and this has been accompanied by a reaching out for more and more hinterland area. The task ahead, accordingly, is to perfect and introduce the necessary organization that will make of both the center of dominance and the hinterland area a unit of democratic participation, thus injecting into their government an element of greater social justice.

Such a scheme of organization, itself a social consequence of no small significance, is associated with other social consequences which, in the Tennessee River Valley, have been, in considerable measure, the result of basin development under an enlightened administration. The Tennessee River Valley, however, is a small basin—David E. Lilienthal described it as sufficiently small so that the benefits of the TVA program could reach all the people in like democratic fashion.[46] And there were other favorable conditions: the basin has several indigenous metropolitan centers of dominance; it has easy access to the entire urbanized, commercial-industrial complex of the East; and it is blessed with high and seasonably favorable precipitation—all of which constitute the ethos of the culture of the nation. From this, it is clear that basin development in the Tennessee River Valley, involving financial contributions from the nation as a whole, could not help but produce socially beneficial consequences of considerable proportions.

In the larger western basins, however, such as that of the Missouri River, where the milieu is considerably different, the same social consequences have not followed upon developmental activity. These basins are considerably larger than that of the Tennessee River and contain a greater diversity of resources and social phenomena. They also have fewer indigenous metropolitan centers of dominance, and those that do

[45] *Id.* at 86.

[46] He states that, in his opinion, the Tennessee River basin is as large as any basin or regional program should be in order to maintain the grass-roots-like and democratic spirit that is basic to such development. LILIENTHAL, *op. cit. supra* note 11, at 154.

exist tend to be located on the periphery or even outside of the basins proper, where they serve national and international interests, rather than those of the basin or the region. Furthermore, in the West, there is a need for basic institutional adaptations to the facts of semiaridity and aridity—adaptations for which there is now little tolerance in the ethos of the national culture. Such adaptations on all levels of living, including industry and business, financing and management, public agency and governmental operations, school and church organization, town-building and community organization, as well as agriculture, must have a focus in the area concerned and must have the functional dynamics that metropolitan centers of dominance can offer.

It is the conclusion of this writer that river basin development, alone, even optimally administered, is unequal to this challenge in the West. These are rather the tasks of true regionalism—not regionalism with hard and fast lines, like state and local government, but regionalism that is boundaryless and that emanates from indigenous metropolitan centers of dominance. This regionalism must serve as a form of social organization to foster democratic participation between the hinterland area and indigenous metropolitan centers of dominance; and it must proceed simultaneously with, if not before, river basin development. Thus only can river basin development be properly channeled and the existing hinterland be saved from still further exploitation by the urbanized, commercial-industrial complex that now has its roots in nonindigenous metropolitan centers of dominance.

River basin development, in basins that traverse several regions, then, is primarily that institutional device by which the seeds of interregional cooperation can be planted and nurtured. This is the distinctive contribution of significant social consequence that river basin development can make to the West; and this may eventually be its role in the smaller eastern basins, too, after it is found necessary to recruit regionalism to bring social justice to hinterland-metropolitan relationships there as well.

THE EVALUATION OF RIVER BASIN DEVELOPMENT

HUBERT MARSHALL*

I

INTRODUCTION

Governments, like private citizens, are faced with the problem of apportioning scarce resources among almost insatiable and competing demands. This fact has led students of government finance to advance the principle of "maximum social advantage," which holds that since resources are limited, they must be allocated among alternative ends in such a way as to yield maximum satisfaction to the members of society. Actually, the principle requires that decision-makers seek answers to two questions in connection with each expenditure proposal. First, it must be asked whether the social benefit derived from a governmental expenditure is greater or less than the aggregate personal benefit which the taxpayers would have derived from the private use of these funds. If greater, according to the principle, the government expenditure is justified; if less, it is not warranted. And second, assuming an expenditure is to be made, it must be asked whether the social advantage is greater if the money is spent on activity *A* or on activity *B*. Thus, the principle requires not only the comparison of alternative expenditures, but a decision as to whether any public expenditure is warranted in light of the sacrifices that taxpayers will be asked to make.

This consideration of alternative uses of limited resources constitutes the heart of the budget process. No doubt, budget-makers at lower echelons of the bureaucracy are not particularly aware of the weighing and evaluating which form a part of their jobs; these processes are done almost subconsciously where policies are well established and the sums involved are small. But budget-makers high in the departments or close to the President and in Congress are very much aware of their role when they compare the relative merits of competing proposals, especially when the programs are large and the stakes are high. In making their decisions, budget-makers are invariably influenced by a variety of factors. The official's own conception of the public welfare may lead him to favor one use over another; yet, his bias may be modified by what he knows the President or Congress or interest groups may insist upon. Thus, the final decision is the product of diverse values and pressures so complex

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in their interrelations that no person may be entirely certain why a particular decision was made.

Because of the importance and complexity of the decision-making process, of which budgeting is an example, students of the behavioral sciences have devoted increasing attention to it in recent years. Students of government have, in particular, been concerned with increasing the rationality of the budget process, in the sense of maximizing the extent to which budget choices are made explicitly and deliberately. In this effort, public administration has sought to develop organizational arrangements and administrative procedures which facilitate the clear formulation and comparison of alternatives; and economics has sought to provide methods of analysis which reveal with increasing clarity the comparative utility of alternative expenditures.

Perhaps the most important contribution of the economists has been to focus attention on the fact that it is not profitable to discuss in the aggregate whether schools, for example, are "more important" than roads. The question that rather needs to be asked is whether the return will be greater from an incremental investment in schools or an equal investment in roads. If one million dollars is available, in which function should it be invested? The answer is found by looking at the marginal social benefit yielded by each of the functions. This is the concept which lies at the heart of marginal analysis as it is used by economists.

So stated, the problem of budgeting takes on a deceptive simplicity. Budget-makers may attempt broad appraisals and independent judgments, but characteristically they find that not one, but numerous values need to be maximized and that these values more often than not conflict. Especially is this true of river basin development, where short and long-range goals and the competing demands of flood control, navigation, irrigation, and power development make conflict inevitable. But this is by no means the only problem. The comparison of utilities is made all the more difficult by the fact that value judgments cannot ordinarily be given quantitative expression and, in any event, cannot be compared with one another in terms of a common unit of value. Were it possible to reduce a variety of conflicting goals to a common unit of value, it would be possible, of course, to rank alternatives according to their comparative utility. But the depressing fact is that neither the Benthamite calculus nor any other system sufficiently lends itself to quantification to eliminate the need for intuition or other subjective mental processes.

Despite these qualifications, considerable progress has been made in recent years in the elaboration of forms of economic analysis which, when properly used, provide decision-makers with a quantified appraisal of the relative merits of alternative water development projects. While the misuse of economic analysis has been common in appraising these projects, it seems fair to say that the true goal of budgeting—the rational comparison of alternatives—is clearly capable of being achieved in the water development field.

Of the three agencies which construct river basin projects and employ economic analysis in their evaluation, the Army Corps of Engineers is the oldest. Although

the Corps' origins go back to the Revolutionary War, it was not asked to undertake civil functions until 1824, when Congress directed the Engineers to clear a navigable channel down the Ohio and Mississippi Rivers. This was the beginning of the Corps's function as "engineering consultants and contractors for the Congress." For nearly a century, the Corps was confined to navigation improvements, although flood control was often a by-product of its undertakings. Beginning in 1917, however, Congress permitted the Corps to construct certain flood works on the Mississippi and Sacramento Rivers, and in the Flood Control Act of 1936,[1] it recognized flood damage as a matter of national concern and authorized the Corps to construct flood works of all kinds, including reservoirs, throughout the country. Since power was recognized as a by-product of reservoir construction, the Engineers were, in fact, thus permitted to enter the business of multiple-purpose river basin development. The Corps is well known, of course, for the pork-barrel legislation which authorizes its projects, for its close ties with local and national organizations which effectively support its program in Congress, and for its ability to circumvent presidential control.[2]

The Bureau of Reclamation, established by the Reclamation Act of 1902,[3] is the agency primarily responsible for the construction of public irrigation projects in the seventeen western states. Created as a logical extension of the homestead concept into the semiarid and arid West, the reclamation program has always been committed to the task of creating family-sized farms, which are visualized as supporting, in turn, numerous small but thriving urban communities. The social idealism of the reclamation program has been buttressed by the acreage and antispeculation provisions of various reclamation laws and by provisions of other laws which give preference in the sale of power to public and cooperatively-owned distribution systems.[4] The social policies of the reclamation program have been both an advantage and a disadvantage to the Bureau in the struggle among competing agencies. The Bureau has won friends among liberal and idealistic groups, but the restrictive nature of the legislation under which it operates has made it comparatively difficult for large landowners to secure windfall gains or for project beneficiaries to escape an obligation to repay at least part of the capital costs of irrigation projects. All things considered, therefore, the Bureau has not had as good public relations as has the Corps, and its program has never been as generously supported in Congress.

The Flood Control Act of 1936 assigned to the Department of Agriculture responsibility for watershed management designed to prevent flood damage. The Department was not immediately geared to the implementation of such a program, apart from its ongoing responsibilities for soil conservation, and World War II super-

[1] 49 STAT. 1570, 33 U.S.C. §701a (1952).

[2] See generally, ARTHUR MAASS, MUDDY WATERS: THE ARMY ENGINEERS AND THE NATION'S RIVERS (1951).

[3] 32 STAT. 388, 43 U.S.C. §391 (1952).

[4] See, *e.g.*, 58 STAT. 890 (1944), 16 U.S.C. §825s (1952). For a description of acreage-limitation and antispeculation legislation, see U. S. BUREAU OF RECLAMATION, DEP'T OF THE INTERIOR, LANDOWNERSHIP SURVEY ON FEDERAL RECLAMATION PROJECTS (1946).

vened before the program could be initiated. Hence, it was not until 1946 that Congress actually appropriated the first funds for watershed control. In the decade which has followed, Agriculture's program has shown no sign of rivaling in size those of the Corps and the Bureau. The Department of Agriculture has had no well-organized constituency to support its flood-control work, and the nature of its task lacks the dramatic quality of harnessing whole rivers with giant multiple-purpose dams. Then, too, the Corps and the Bureau have done what they could to secure congressional restrictions of one sort or another on the watershed program. Although Agriculture's program has remained comparatively small, its plans are big, and if support can be developed, its program may rival in size those of its two competitors.

II

Economic Evaluation

Because of the limitations of funds and the fact that projects in all parts of the country have their enthusiastic supporters, it has been necessary for Congress and the construction agencies to develop criteria for evaluating water development projects. Two general tests—financial feasibility and benefit-cost analysis—have been devised. When conservatively used, both provide decision-makers with quantitative information which makes it possible to rank projects in the order of their contribution to the general welfare, at least to the extent that this can be measured by tangible utilities and disutilities. The rank order is a rough one and must be qualified by our inability to quantify certain intangible factors (extramarket values) which may make projects more or less desirable; but these tests, when properly used, are capable of providing at least a rough guide to decision-makers.

The test of financial feasibility has been applied over the years only to irrigation projects. The Reclamation Act of 1902 provided that water users on federal irrigation projects must contract to repay the capital costs of these projects, without interest, over a period of ten years. The interest subsidy was widely regarded as justified because of the national interest in the social objectives of the program; and in any event, it was a smaller subsidy than that provided for navigation and later for flood-control projects, which do not require repayment of capital costs. When the first settlers proved unable to meet the repayment requirements, Congress extended the period to twenty years in the Reclamation Extension Act of 1914,[5] then to forty years in the Omnibus Adjustment Act of 1926,[6] and finally to fifty years in the Reclamation Project Act of 1939.[7] Thus, although the period has gradually lengthened, the test has remained one of the ability of the settlers to reimburse the federal government for its investment in the project. Repayment ability, in turn, has been regarded as a measure of the worthwhileness of the project, since it reflects project costs, the availability of water, the fertility of the soil, and other factors which have a bearing on the comparative utility of projects.

[5] 38 Stat. 686.

[6] 44 Stat. 636, 43 U.S.C. §423e (1952).

[7] 53 Stat. 1187, 43 U.S.C. §485 (1952). This act continued the forty-year repayment period but provided for an initial ten-year development period during which no payment is required.

While any project meeting the test of financial feasibility might be authorized, the expectation was—and no doubt the practice has been—that the Bureau would seek authorization to construct those projects first which would "pay out" in the least number of years. In this sense, then, the test of financial feasibility provides a rank order of projects. In practice, of course, political and other factors have played an important role in determining the order in which projects are constructed, but this fact does not vitiate the statement that calculations of financial feasibility can provide decision-makers with valuable information which has the effect of sharpening alternatives and providing a more rational basis for reaching conclusions.

Benefit-cost analysis is perhaps a better test of the worthwhileness of a project, since it can be used to measure a wider range of factors than does financial feasibility. The use of benefit-cost analysis grew out of section 1 of the Flood Control Act of 1936, which provided that:[8]

> . . . the Federal Government should improve or participate in the improvement of navigable waters or their tributaries, including watersheds thereof, for flood-control purposes if the benefits to whomsoever they may accrue are in excess of the estimated costs, and if the lives and social security of people are otherwise adversely affected.

Although the act applied specifically only to the Corps of Engineers and the Department of Agriculture, the Bureau of Reclamation found it expedient to join with the other agencies in efforts to elaborate a system of project evaluation which would meet the act's requirements. Benefit-cost analysis was the result.[9] In this form of economic evaluation, two categories of benefits and costs are recognized: (1) tangible benefits and costs, which are susceptible of measurement in monetary terms; and (2) intangible benefits and costs (extramarket values), which cannot be converted to monetary equivalents. Almost necessarily, this form of evaluation places greater emphasis upon tangible benefits and costs, although the intangibles are not necessarily ignored. Customarily, tangible benefits and costs are reduced to dollar equivalents and expressed as a ratio of benefits to costs. If this ratio is in excess of unity, it is generally considered that the project is economically justified. Intangibles are compared qualitatively in prose form and, on the whole, play a rather unimportant role, at least in a formal sense, in project justification.

In the calculation of benefit-cost ratios, economists recognize two types of tangible benefits and costs—primary (direct) and secondary (indirect). Primary benefits

[8] 49 STAT. 1570, 33 U.S.C. §701a (1952).

[9] A considerable literature has developed on this subject in the last few years. See SUBCOMMITTEE ON BENEFITS AND COSTS OF THE FEDERAL INTER-AGENCY RIVER BASIN COMMITTEE, PROPOSED PRACTICES FOR ECONOMIC ANALYSIS OF RIVER BASIN PROJECTS (1950); NATIONAL WATER POLICY PANEL OF THE ENGINEERS JOINT COUNCIL, PRINCIPLES OF A SOUND WATER POLICY (1951); House Committee on Public Works, *Economic Evaluation of Federal Water Resource Development Projects*, 82d Cong., 2d Sess. (1952); Clarenbach, *Reliability of Estimates of Agricultural Damages from Floods*, and Curran, *Evaluation of Federal Navigation Projects*, in 3 U. S. COMM'N ON ORGANIZATION OF THE EXECUTIVE BRANCH OF THE GOVERNMENT, WATER RESOURCES AND POWER 1275, 1317 (1955) (second Hoover Commission Report); Wantrup, *Benefit-Cost Analysis and Public Resource Development*, 37 J. FARM. ECON. 676 (1955); and OTTO ECKSTEIN, BENEFITS AND COSTS: STUDIES IN THE ECONOMICS OF PUBLIC WORKS EVALUATION (unpublished doctoral dissertation in Harvard University Library 1955).

and costs are those that arise directly and immediately from the projects. Primary benefits include reduction of flood damage, increases in net income resulting from the higher use of property made possible by flood control, increases in net income from lands benefited by watershed treatment measures or rendered more productive by irrigation, savings in transportation costs resulting from navigation projects, and the value of power from a hydroelectric project. Primary costs include the actual cost of constructing the project, its operation and maintenance, losses in state and local tax revenues, and the abandonment of economically useful structures, such as locks and bridges.

Secondary benefits have been defined as "the values added over and above the value of the immediate products or services of the project as a result of activities stemming from or induced by the project."[10] Those values "stemming from" a project are usually thought of as accruing from the processing of the products of a project, such as the milling, transportation, and baking of wheat produced on an irrigation project. Thus, the value of bread over and above the value of its wheat content would be a secondary benefit. Values "induced by" a project include the increase in economic activity resulting from expenditures by the producers of the immediate products of a project. These would include the increased income of local businesses that serve the project area. Secondary costs comprise the costs of further processing the immediate products or services of the project and the costs incurred by local businessmen in meeting the increased demand for goods and services in the project area. As a matter of convenience, it is customary to speak of *net* secondary benefits, which are equal to secondary benefits less secondary costs.

To the uninitiated, the calculation of a benefit-cost ratio may seem a fairly simple matter. But economists are not entirely agreed as to either the principles or the details of practice; and the agencies, driven by competitive and political pressures to find favorable ratios, have been unable to agree on what constitutes a benefit, how its monetary value should be determined, what amortization period should be used for structures, what interest rates should be considered applicable in financing, and whether or not net secondary benefits may legitimately be counted during periods of full employment. For more than a decade, the agencies, primarily through the Federal Inter-Agency River Basin Committee and its successors, have wrestled with these issues without reaching agreement. In 1952, Circular No. A-47, issued by the Bureau of the Budget, imposed a degree of uniformity of method on the agencies but left a number of questions unsettled, including the problem of secondary benefits.

Despite the complexities and unsettled problems of benefit-cost analysis, however, its ultimate objective should be kept in mind. This, in the words of the Subcommittee on Benefits and Costs, is to[11]

> . . . ascertain the extent to which the use of economic resources such as the land, labor, and materials necessary for a project is more or less effective than would be the case if the project were not undertaken.

[10] SUBCOMMITTEE ON BENEFITS AND COSTS, *op. cit. supra* note 9, at 9.

[11] *Id.* at 5.

When properly used, it should result in a rank order of projects based on their relative efficiency in the use of economic resources. Benefit-cost analysis is, thus, a major aid to budgeting, in the sense that it facilitates the comparison of alternatives and creates an environment in which choices can be made explicitly and deliberately. Potentially, at least, it has much to contribute to a science of rational social choice.

III

REclamation Repayment and the Test of Financial Feasibility

As we have seen, the early settlers on federal irrigation projects were unable to meet their repayment obligations in the periods of time specified in law. Accordingly, the repayment period was extended from ten years in 1902, to twenty years in 1914, to forty years in 1926, and finally to fifty years in 1939. Despite these extensions in general law, it has frequently been necessary for Congress (1) to make non-reimbursable a portion of the construction costs of some projects, (2) to write off construction charges the settlers are unable to repay, and (3) to extend the repayment period beyond the fifty-year standard set in the Reclamation Project Act of 1939. The sums involved in the first two categories are difficult to determine from bureau figures but are not large in terms of the total program. Settlers on a majority of the projects which have been in existence for some time, however, have, at one time or another, been unable to meet their repayment obligations, and Congress has found it necessary to extend the repayment period. Such action has the effect of increasing the subsidy to irrigation, since the federal government must continue to pay interest on the unpaid balance. Over a fifty-year period, at three per cent interest, the interest subsidy borne by the Government is approximately equal to the construction costs. When the repayment period is extended beyond fifty years, the subsidy becomes proportionately greater.

Because of the way in which reclamation repayment figures are published, it is difficult to determine precisely the repayment histories of many projects.[12] However, Joss has made a study of the repayment record of twenty-seven projects which had received water by 1918.[13] His study carried these projects through 1938. Of the projects he analyzed, five have been abandoned as having no hope of paying out and as likely to represent a continuing loss to the Government. Of the remaining projects, four will require more than 250 years to pay out, five will require between 125 and 250 years, six will require seventy-five to 125 years, and the remaining seven projects will pay out in less than seventy-five years, based on their repayment experience between 1918 and 1938.

More recently, a study by the Subcommittee on Irrigation and Reclamation of the House Committee on Interior and Insular Affairs revealed that in the five years between 1947 and 1952, repayment contracts of eighteen projects were amended to

[12] See U. S. Bureau of Reclamation, Dep't of the Interior, Repayment Histories and Payout Schedules—1952 (1953).

[13] Joss, *Repayment Experience on Federal Reclamation Projects*, 27 J. Farm Econ. 153 (1945).

extend the total length of the repayment period.[14] Six of these projects will now require periods in excess of 100 years to pay out. Two additional projects will not return capital costs to the Government within their useful lives. One of these would require 328 years to pay out, if the project works were to last that long. The remaining ten projects are expected to pay out in from fifty to ninety-nine years.

Since the Bureau had constructed only seventy-one projects by 1952, and since a number of these were, at that time, of such recent origin that repayment obligations had not fallen due, the conclusion seems inescapable that the test of financial feasibility is not serving its purpose. In actual fact, most of the projects with repayment histories of ten years or longer have needed some form of deferment or relief from repayment obligations.[15]

Despite the failure of reclamation projects to pay out as expected, the program has numerous supporters in and out of Congress, many of whom use economic arguments of dubious validity in defense of the program. Thus, the point is often made that nearly all projects are current in their repayment obligations. But such statements conveniently ignore the fact that delinquencies are periodically funded and, through an amendatory contract, result in an extension of the repayment period. The depressing fact rather is that in terms of their original contracts, most of the projects with a substantial repayment history are not current in their repayment obligations.

The defenders of the program also lay much stress on the argument that capital costs are repaid to the Government. While this is more or less true in fact, the great care with which these same advocates avoid any mention of the size of the interest subsidy—now more than fifty per cent of project costs—leads one to believe that they are less than candid with their audiences. However, it should be kept in mind that repayment on the part of irrigation beneficiaries is considerably greater than that of the beneficiaries of navigation and flood-control projects, the capital costs of which are borne almost wholly by the federal government. But despite this reservation, it seems clear that the test of financial feasibility serves more as window-dressing for the program than as a real test which proposed projects are expected to meet. No

[14] Subcommittee on Irrigation and Reclamation of the House Committee on Interior and Insular Affairs, *Construction Costs and Repayment on Federal Reclamation Projects*, 82d Cong., 2d Sess. (1952).

[15] Many of the projects completed in recent years or still under construction have brighter repayment prospects. This is because the capital costs of these irrigation projects, through devices such as the "interest component" and the "basin account"—will be repaid from the "surplus" revenues of hydroelectric projects. The Upper Colorado River Storage Project is a good example of a project made financially feasible only because power consumers will repay a substantial portion of the irrigation costs. Roy Huffman, in his *Irrigation Development and Public Water Policy* (1953), at p. 174, says: "Obviously, the basin account would discriminate in favor of irrigation development in river basins with great hydroelectric power resources. Specifically, it would make possible in one river basin (such as the Columbia) the development of irrigated lands which were inferior to lands in another river basin where the lesser power resources did not provide sufficient subsidy. Rather than aiding the expansion of public irrigation development throughout the West, the basin account system might tend to limit it to regions possessing great quantities of hydroelectric power." It can be argued, on the other hand, however, that the power subsidy to irrigation is a means of securing repayment aid from the secondary beneficiaries of irrigation projects. Nevertheless, we might be better off to pass up the hopelessly inefficient irrigation projects and concentrate on straightforward power projects, with or without flood storage.

doubt, it also serves a useful function as a means of comparing alternative projects, since the inflation of expectations has no harmful effect provided the degree of optimism does not vary among projects. But as a measure of whether a project should be constructed or the money be allowed to remain in private hands, the test does little more than throw a cloak of respectability around the program. If the projects are justified by a comparison of benefits and costs, then the test of financial feasibility might well be abandoned. Or if the public interest in irrigation justified public assumption of the interest charges for more than fifty years (resulting in a subsidy in excess of fifty per cent of the total cost of the project), Congress might appropriately change the standard to provide for a longer repayment period. But Congress has never been willing to do this, and one is led to conclude that the program receives its backing more from the political strength of its supporters than from any widespread feeling that its contribution to the public interest justifies a repayment period in excess of fifty years.

IV

BENEFIT-COST ANALYSIS: ITS USE AND ABUSE

The second form of economic evaluation, benefit-cost analysis, is used by all three construction agencies. In this respect, it is unlike the test of financial feasibility, which is used only by the Bureau of Reclamation. As indicated above, economists are by no means in complete agreement on the details of benefit-cost methodology. But operationally useful definitions and approximations make it an effective tool of economic evaluation when properly employed. Unfortunately, its actual use by construction agencies raises grave doubts as to the reliability of the ratios that are calculated for the use of decision-makers. In this regard, two matters must be considered. The first concerns the legitimacy of counting secondary benefits, and the second has to do with the overestimation of primary benefits.

It will be recalled that secondary benefits are defined as the values added over and above the value of the immediate products or services of the project as a result of activities stemming from or induced by the project. These secondary benefits arise from the increase in economic activity accruing from the processing of the products of a project and the expenditures of the primary beneficiaries of the project. Secondary benefits, however, should be net of the costs incurred in secondary activities *and should also be net of any surpluses in secondary activities that would be expected from other uses of project resources.* In economic evaluation, the agencies have agreed to assume an expanding economy and the prevalence of relatively high levels of resource employment (*i.e.,* full employment). These assumptions have generally been consistent with the facts during the years in which benefit-cost analysis has been employed. Under these conditions, it must be assumed that alternative opportunities exist for the use of project resources and that these uses would produce secondary benefits. From a national standpoint, it can be argued that the secondary benefits of one project are approximately equal in value to the secondary benefits

that would arise if project resources were used in an alternative investment elsewhere, whether public or private. Therefore, on the assumption that the resources would be used elsewhere, there would be no net secondary benefits attributable to a project. Or, to word it somewhat differently, from a national standpoint, secondary benefits are approximately offset by secondary costs, if the latter include foregone opportunities to reap secondary benefits from public or private investments in other localities.

Two additional points, however, remain to be made. The first is that economists are generally agreed that water development projects have important net secondary benefits during periods of unemployment. Under depression conditions, alternative private investments would not necessarily be made, and, hence, there is no basis for insisting that the secondary benefits of a public project be reduced by the amount of secondary benefits that would accrue from a marginal alternative investment elsewhere.

The second point which needs to be made is that the analysis of secondary benefits presented above reflects a national point of view. Net secondary benefits, even in periods of full employment, do exist for regions and localities. If, for some reason, policy-makers wish to alter the pattern of income among regions, among industrial or occupational groups, or among individuals, the counting of at least certain types of secondary benefits becomes legitimate. Projects of this sort may not increase the real national income, but they can achieve a variety of social objectives. Needless to say, explicit statements of social objectives of this sort are seldom forthcoming from policy-makers, and in their absence, except under circumstances of unemployment, the counting of secondary benefits does not seem justified.

Of the three agencies under consideration here, only the Bureau of Reclamation counts secondary benefits in such a way that they play an important role in securing favorable benefit-cost ratios. The other agencies either do not compute them or ordinarily do so in such a limited way that their methods are not subject to criticism. The differences between the agencies on this matter lie at the heart of most of their disagreements on benefit-cost analysis. Although the Bureau has consistently stood alone in the secondary benefits debates of the Federal Inter-Agency River Basin Committee, its position is clearly dictated by the fact that most irrigation projects depend upon the counting of "secondaries" for favorable ratios. Indeed, in the justification of many projects, the Bureau depends more heavily upon secondary than upon primary benefits.

The agencies' disagreements are reflected in the report of the Subcommittee on Benefits and Costs and, at one time, were referred to a Panel of Consultants by the Bureau of Reclamation.[16] In 1952, the dispute over secondary benefits was reviewed by a congressional committee (commonly known as the Jones Subcommittee), which made the following comments:[17]

[16] PANEL OF CONSULTANTS ON SECONDARY OR INDIRECT BENEFITS OF WATER-USE PROJECTS, REPORT TO MICHAEL W. STRAUS, COMMISSIONER, BUREAU OF RECLAMATION (1952).

[17] House Committee on Public Works, *supra* note 9, at 51.

> Some of the effort to place monetary values on indirect [secondary] benefits is nothing short of ludicrous. It is time to stop using money and manpower on these refinements that serve only an expedient, self-deception. . . .
>
> It is the view of the subcommittee that even though those devising these computations may not realize their vulnerability, the higher authorities of the agencies who knowingly approve the use of such dubious factors seem to be deliberately participating in an attempt to mislead themselves if not the Congress and the public at large. The use of such hypothecated benefits in a computation would tend to create doubt in the validity of the entire presentation of the agency.

More recently, Professor Wantrup, who has devoted as much time as anyone to studying the economic evaluation of water development projects, supported the Subcommittee when he wrote: "When one tries to draw conclusions from this analysis of secondary benefits and costs, one is forced to suggest that all classes of secondary net benefits be dropped from consideration. . . ."[18]

Although the counting of secondary benefits is frowned upon by most of the agencies and most economists, this fact has not restrained the Bureau's supporters from using a popular variation of the secondary benefits thesis, perhaps best described as the "pebble-in-the-pond" argument. According to this argument, irrigation projects are justified because of their far-reaching economic effects, which, like the ripples caused by throwing a pebble in a pond, spread out in concentric circles far beyond the immediate project area. This thesis was well stated by Senator Watkins in 1955, when he argued that the Upper Colorado River Storage Project was justified because "it will provide a great increase in homes, jobs, national income tax, and individual contentment, as well as provide a second line of civil and military defense for the nation as a whole."[19] What the Bureau's friends forget is that another pebble thrown into another pond would quite probably create just as many "secondary" and "intangible" ripples.

Although the Corps of Engineers and the Department of Agriculture have taken a pious position with regard to secondary benefits, recent evidence seems to suggest that these agencies have devised less conspicuous means of accomplishing the same end. This evidence leads to a consideration of our second major problem—namely, the apparent overestimation of primary benefits. The opportunities for this kind of maneuver become apparent when one reflects upon the kinds of estimates and projections which necessarily are incorporated into benefit-cost ratios. Such factors as crop yields, cost of production, and prices of agricultural products which would be produced on lands in proposed irrigation, flood-control, and watershed projects are, of course, not present facts, and estimates of these quantities are notoriously subject to wide margins of error. Much the same can be said of estimates of the kinds and quantities of materials which would be transported by water as a result of the construction of a navigation project. On the physical side, also, hydrologic science has not provided firm answers for many fundamentally important questions concerning

[18] Wantrup, *supra* note 9, at 688.

[19] N. Y. Times, March 29, 1955, p. 17, col. 2.

the behavior of water on and in the soil and in underground and surface reservoirs and streams. More or less informed guesses must be resorted to, for both physical and economic "data." This means that the door is open for various kinds of fudging, sometimes buried deep in bulky volumes of survey reports or in agency files.

In light of these obvious temptations, it is surprising that no central staff agency of the federal government has ever investigated the soundness of the actual field estimates of the benefits which find their way into benefit-cost ratios. The National Resources Planning Board might have undertaken this function, but it was abolished by Congress in 1943. It is a logical responsibility of the Bureau of the Budget, but insufficient staff or perhaps the political repercussions of such a move may have made it seem unwise. Why Congress has never seen fit to investigate the accuracy of benefit-cost calculations is perhaps more apparent. In any event, it remained for the second Hoover Commission's Task Force on Water Resources and Power to undertake such an inquiry.

An element of major significance in the evaluation of flood-control projects is the estimation of agricultural damages from floods. Many projects are "justified" by the Corps of Engineers and the Soil Conservation Service (Department of Agriculture) largely on the basis of claimed reductions of flood damage to agriculture and an associated land enhancement which results from the higher economic use to which land is put when protected from floods. Hence, the Task Force inquiry, conducted by Professor Fred A. Clarenbach, was directed principally to securing an answer to the question: "Are the estimates of agricultural flood damage and of land enhancement from flood reduction [made by the two agencies] reasonable and dependable?"[20] The methodology of the inquiry involved an examination of the work-sheets of the two agencies and interviews with agricultural economists, independent appraisers, bankers, farmers, and others who are intimately acquainted with the productivity and value of agricultural land in a small number of basins in Kansas, Oklahoma, and Texas on which the agencies had recently completed calculations of benefit-cost ratios.

One area investigated comprised that reach of the Verdigris River, from the Toronto Dam site downstream to the upper limit of the Neodesha Reservoir, in southeastern Kansas. The area of cultivated land in the reach was reported by the Corps as 10,430 acres, valued at an average of $94 per acre. The Corps claims many benefits arising from construction of the Toronto Dam, but perhaps the most easily verified were direct crop damages and other direct damages to agriculture (including supplies, stock and equipment, land, and improvements) which the Corps claims will be averted if floods are checked by construction of the dam. Corps data, based on 1949 prices, indicate that in "flood free years" the "net earning power" per acre of cultivated land is $8.28. For the same area, the Corps estimated average annual crop damages due to floods of $6.87 per cultivated acre. Other estimated annual (noncrop) losses to agriculture came to $0.97 per cultivated acre,

[20] Clarenbach, *supra* note 9, at 1278. The analysis which follows is taken entirely from this report.

making a total average annual loss of $7.84 per acre. If these corps figures are accurate, these flood losses leave a residual net return to cultivated land of only $0.44 per acre. At a capitalization rate of five per cent, this annual return of $0.44 would justify a land value of only $9 per acre. Nevertheless, actual land values, as noted, are approximately $94 per acre.

The most reasonable explanation for the evident inconsistency in the Corps's appraisal results would seem to be that direct flood damages were significantly overestimated. Clarenbach's interviews with farmers, professional hydrologists, and agricultural economists seemed to indicate that "the Corps does not take adequate account of what some informants considered were important net beneficial effects of some floods in improving moisture and soil conditions."[21] Some farmers stated candidly that they did not get a good crop unless their lowlands were inundated during the spring.

Clarenbach also investigated the work of the Soil Conservation Service above Lavon Reservoir on the East Fork of the Trinity River in northwest Texas. In this area, the SCS is engaged in a program of installing runoff and waterflow retardation structures and soil-erosion prevention measures. On the basis of 14,343 acres subject to flooding, the SCS estimates an average annual direct damage to crops and pasture of $34.98 per acre. Yet the *net* residual return to flood-free bottom land averages only about $18 per acre per year, after the deduction of production costs, taxes, and incidental maintenance charges. What the SCS is saying is that the farmers in this area annually lose more from flood damages than their land can produce even in a flood-free year! This is simply not believable. As Clarenbach says: "Though farmers are not perfect economic calculators, neither are they economic imbeciles."[22]

The analyses summarized above deal only with estimates of direct flood damages to crops and pasture. Both the Corps and SCS claim additional large benefits for indirect damages and for land enhancement. Clarenbach found these estimated benefits subject to equal or greater inflation. Hence, it is clear why Clarenbach refers to the economic evaluations now conducted by the agencies as a "considerable accumulation of absurdities,"[23] why the Jones Subcommittee holds that benefit-cost analysis serves "only an expedient self-deception,"[24] and why Wantrup —more given to scholarly understatement—says that "benefit-cost analysis can be and has been distorted and abused."[25]

The misuse to which benefit-cost analysis has been put must now be regarded as a matter of common knowledge among decision-makers high in the departments, in the Executive Office of the President, and in Congress.[26] Not only has

[21] *Id.* at 1283. [22] *Id.* at 1290. [23] *Id.* at 1298.

[24] House Committee on Public Works, *supra* note 9, at 51.

[25] Wantrup, *supra* note 9, at 676.

[26] The examples cited in the foregoing paragraphs deal with the overestimation of flood-control benefits. For analyses of navigation projects, see Curran, *supra* note 9, and MISSOURI BASIN SURVEY COMM'N, MISSOURI: LAND AND WATER (1953). While the Corps of Engineers claimed $11,795,000 annually as benefits from erosion control along the Missouri, the Missouri Basin Survey Commission estimated these

the corruption of economic evaluation been noted by scholars, but the bureaucratic struggles of the great construction agencies have led to a series of reciprocal indictments which have laid the record open for all who care to look. Yet, the political pressures are such that serious interest in the reform of economic evaluation is conspicuous for its absence.

As presently used, benefit-cost analysis constitutes a clear and present danger because of the great influence which favorable ratios carry. In a culture such as ours, influenced as it is by the semantics of a market economy, it becomes near heresy to oppose an investment which, we are assured, will yield a sizable return. The idea of investment and return, neatly packaged in the form of a ratio incorporating only factors having a market value, has such a powerful command over the imagination that one can only credit the agencies with a master stroke in their adoption of this technique for the justification and defense of their programs. Again, as with the test of financial feasibility, there is little correspondence between what men know and what they say. Although many congressmen and certainly most agency decision-makers are aware of the debasement of benefit-cost analysis, the survey reports are full of them, and in their speeches, congressmen assure their colleagues that the nation cannot afford to forego the opportunity to make investments which will yield an excess of returns.

Another problem created by the heavy dependence upon benefit-cost analysis is the subordination of intangible benefits and costs in economic evaluation. These, it will be recalled, are benefits and costs which are not readily reduced to monetary equivalents. Often they are referred to as extramarket values. By whatever name they are called, they are real and often of great significance; and nearly all economists agree that they should be considered in project evaluation. Included among the intangibles are scenic and recreational values (including wildlife), the saving of human life through flood control, strengthening the national security, and the encouragement of a more widely-dispersed industry. The importance of these values will be appraised quite differently by different individuals, but that does not lessen their significance nor warrant their being ignored in project evaluation. The usual suggestion is that these values be outlined and evaluated in prose form. Yet, experience shows that agencies are unwilling to recommend projects with unfavorable ratios, even when a strong case can be made for them on the basis of intangible benefits. Perhaps this dilemma need never arise, because of the ease with which favorable ratios can be manufactured. But it seems partly, at least, to be a product of our dependence upon the symbols of the business world,[4] and to this extent, the emphasis which the agencies and Congress place upon benefit-cost ratios detracts from the consideration which important extramarket values might otherwise receive.

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at $964,000. Annual savings due to the navigation project the Corps estimated at $6,699,000, while the Commission estimated them at $2,050,000. For the navigation project as a whole, the Corps calculated a benefit-cost ratio of 1.9 to 1; the Commission arrived at a ratio of 0.8 to 1.

V

EXTRAMARKET VALUES: CLOAK FOR SELF-INTEREST?

It is a characteristic of politics that self-interest often masquerades in the form of lofty principle, for only in this fashion can it achieve the widespread public support which it needs. Thus, Locke took pen in hand after the Glorious Revolution to provide a theoretical defense for what had taken place, and the American Revolution was ably justified by Paine, Jefferson, and others using arguments which perhaps had comparatively little to do with the real issues of the controversy. Much the same can be said of many arguments offered in justification of river basin projects.

Clearly, many supporters of water development projects come to their position because of the important intangible public benefits provided by such projects. The preservation of lives through flood control and the enhancement of scenic and recreational values are perhaps the most unchallengable of these. But other justifications are set forth which inevitably lead the observer to wonder how sincerely they are offered and to what extent they are used to cloak objectives of more immediate self-interest. This concern becomes all the more important when one realizes the huge stake which contractors, navigation interests, shippers, landowners, and others have in the enormous subsidies provided through water development projects. In this part, we shall examine some of the arguments which have been most powerful in mobilizing support behind these programs. Because of the writer's familiarity with the reclamation program, most of the illustrations are drawn from it. Equally good examples, however, could be drawn from flood-control, navigation, power, and watershed-control programs.

Perhaps the most powerful force operating in support of the reclamation program has been a consistent interest on the part of our people in development of the West. For many, this nation has had a "manifest destiny" first to push back the frontier and then populate and develop the West. This has been America's challenge, and one generation after another has had its imagination captured by the romance of subjecting western lands and water to human control. From Horace Greeley's "Go West, Young Man" to the recent Davy Crockett craze, America's fascination with the West has remained undiminished.

Much of the interest in irrigation in the West has been stimulated by outright promoters. One of the most influential of these was William E. Smythe, who wrote *The Conquest of Arid America* (1899), which included chapters entitled "Greatness by Continental Conquest," "The Better Half of the United States," "The Blessing of Aridity," and "The Miracle of Irrigation." From Smythe's day to present times, the West has had its advocates. Thus, Clarence Davis, while Under Secretary of the Department of the Interior, told an audience:[27]

[27] Speech before the Idaho State Reclamation Association, Idaho Falls, Idaho, April 25, 1955. Interior Department News Release, April 25, 1955.

It is a great program to which the Bureau of Reclamation was originally dedicated—the development of the land and water resources of the West. We should revise our thinking. We should look at those things which are of fundamental importance. We should strive to build the West.

The logical conclusion to much of this kind of promotional argument is the doctrine that the West has a right to be developed, even though alternative investments elsewhere would add more to the real national income. This is the official position of the Department of the Interior. Writing in criticism of a Bureau of the Budget directive which provided that projects should be evaluated, in part, on the relative economy of alternative means available on a national basis for meeting the needs to be met by the project, Ralph Tudor, while Acting Secretary of the Interior, said:[28]

The Reclamation program is basically a Western States land and water resource development program. . . . In an Interior report there is no occasion for comparing the relative merits of a proposed Federal irrigation development with some other reclamation possibilities, such as draining of swamp lands. The basic test should be: (1) whether a proposed development is needed and is favorable from an economic standpoint; and (2) its relationship to a balanced over-all national program. With respect to test (2), State and regional needs . . . may outweigh considerations resulting from strict economic evaluation on a national basis. This element of balanced development . . . may be disregarded if emphasis is placed on nation-wide competition of alternatives.

Thus, we have the view that "balanced development" requires that regions be developed more or less equally, or on some other "fair" basis, even though alternative investments in other regions—perhaps already more highly developed—might contribute more to the real national income. Promoters and those with vested interests to defend are not always alone in this point of view. The growth of regionalism as a concept and as an aid to analysis in economics, sociology, geography, and political science has perhaps caused some scholars to hold regional values higher than national ones.[29] Thus, William E. Folz criticizes Wantrup for failing to "consider as a benefit the psychological value society derives from the development of a region."[30] Points of view such as this raise serious philosophical and economic questions, which, needless to say, merit the most careful attention. Clearly, one cannot satisfy such "psychological values," if they really exist, and, at the same time, maximize the economic returns from either public or private investment. Inevitably, one is led to ask whether those who defend

[28] From a memorandum entitled "Comments and Recommendations for Revision of Bureau of the Budget Circular No. A-47," attached to a letter from Ralph A. Tudor, Acting Secretary of the Interior, to Joseph M. Dodge, Director, Bureau of the Budget, Jan. 14, 1954.

[29] For a discussion of the role which regional analysis can play in each of the social sciences, see Garnsey, *The Dimensions of Regional Science*, in 2 PAPERS AND PROCEEDINGS OF THE REGIONAL SCIENCE ASSOCIATION 27 (1956).

[30] In *Water Resources and Economic Development of the West: Benefit-Cost Analysis*, a paper presented at the meeting of the American Association for the Advancement of Science, Dec. 27, 1954, Berkeley, Cal.

regional values are not really interested primarily in the development of their *own* region.

A second justification of the reclamation program is that it creates farm homes and their dependent, small urban communities. In the Bureau's publications, these values are referred to as settlement opportunities. There is little doubt that the Reclamation Act of 1902 was regarded as a home and community-building measure. The 160-acre limitation of federal reclamation law, reiterated in legislation more than a dozen times in forty years,[31] is clearly designed to promote the creation of family-size farms. This goal was and still is regarded by many as important enough to justify heavy subsidy to the irrigation program.

This justification of the reclamation program has its roots in a romantic attachment to an earlier day—to farming as a stable, sound way of life which is worth preserving in a world of uncertainties, radical ideologies, and unsettling social changes. Much of the writing in defense of the irrigation program is antiurban in outlook. Thus, an important Interior official recently said:[32]

> There are millions of acres of underdeveloped land in the West . . . , much of which can be the scene of comfortable farms, of thriving communities and a much happier life for many of our people than they can lead in the congested industrial centers and big cities of other parts of the country.

And an Interior publication, justifying the Missouri Basin Project, says of irrigated areas:[33]

> They will provide a land-use situation that *will help stem the present tide of urbanization* by throwing out into the area a series of life-lines, which will help hold a stabilization line below which the proportion of rural population in the area may be kept from falling.

Thus, much of the writing in defense of the irrigation program appeals to a lingering dissatisfaction which the urban majorities of the East have in their mode of living and capitalizes on a romantic attachment which nearly all Americans have to farming as a way of life.

A closely related objective of the reclamation program is the stabilization of human occupancy of the Great Plains. Because of extreme variations in the amount and distribution of rainfall, farming and ranching on the plains have always been hazardous undertakings. The inevitable problems of wresting a living from the soil under the conditions prevailing on the plains was complicated historically by the fact that the men and women who peopled the West brought with them a background of experience in lands of greater humidity and tried to impose their ways of farming on this new land. The result has been an unstable agriculture and, at times, the emergence of problems of truly national concern—as illustrated by the dust bowl of the 1930's and the current distress in the drought-stricken Southwest.

[31] See U. S. BUREAU OF RECLAMATION, *op. cit. supra* note 4, at 29.
[32] Clarence A. Davis, Under Secretary of the Department of the Interior, Release, *supra* note 27.
[33] Ickes, *Missouri River Basin*, S. Doc. No. 191, 78th Cong., 2d Sess. 145 (1944) (emphasis supplied).

An important defense of the irrigation program in the Missouri basin, where project beneficiaries are able to repay only a small fraction of capital costs, is based on this concept of "stabilization." Thus, one of the authorizing documents for the Missouri Basin Project states:[34]

> There is not enough water in the Missouri River to irrigate the entire basin, but there is enough to create hundreds of islands of safety, some stretched like necklaces of narrow ribbons along streams in the basin; some larger blocks created by the diversion of available waters to irrigable areas.

These "islands of safety" are expected to provide a safe type of agriculture for the families living on them, supplementary feed and forage for adjacent dry-land farmers (thus reducing the need to liquidate valuable livestock during drought years), and a steady flow of high-value agricultural products, the processing of which will provide employment in the area, even during years of deficient rainfall.

The "stabilization" argument is sometimes extended to include the "rescue of stranded areas." This was the avowed objective of the Central Arizona Project,[35] which was never authorized by Congress. This project was designed to bring water to 150,000 acres of land which had only insecurely been brought under cultivation in the first place. The project would have cost more than a billion dollars, none of which could have been repaid by the farmers. While this project never secured congressional approval, it differs only in degree from numerous others in the Missouri basin.

Many other arguments are, of course, also offered in justification of the reclamation program. Some, like the argument that projects result in an increase in federal income taxes, are only variations of the secondary-benefits argument and have no validity during periods of full employment, since alternative investments would produce the same effects. Others in this category include the arguments that projects provide "additional employment opportunities" and provide "new wealth where none existed before."

Our interest in these extramarket values stems from a concern about their validity. Social scientists are presented here with a difficult question: Do Americans "really" wish to develop the West, create settlement opportunities on new farms, or stabilize agriculture on the Great Plains, despite the fact that these ventures are often uneconomic in the sense that their benefit-cost ratios, if legitimately calculated, would be less than unity? Or are these justifications merely designed to cloak the desire for subsidy, windfall gains, or other forms of economic advantage which are an inevitable accompaniment of these projects?

We know that powerful economic interests have much to gain from water development projects. The irrigation and watershed programs are heavily subsidized, and navigation and flood control beneficiaries return no part of the capital

[34] *Id.* at 144.

[35] See U. S. Bureau of Reclamation, Dep't of the Interior, *A Report and Findings on Central Arizona Project*, H. R. Doc. No. 136, 81st Cong., 1st Sess. (1949).

costs to the federal treasury. And we know that the economic interests which benefit from these projects are well-organized. According to Huffman, the National Reclamation Association "is made up primarily of the representatives of chambers of commerce, agricultural development departments of railroads, real estate agencies, and promotional groups in general," and membership in the National Rivers and Harbors Congress "is heavily weighted with representatives of the construction industry and allied businesses—people whose future depends on the type of work involved in river and harbor improvements."[36] We know also that the roughly 50,000 employees of the three agencies under consideration here constitute a huge bureaucracy with an enormous stake in the continuation and expansion of their programs.[37]

Unfortunately, we are dealing here with complex problems of human motivation. The human mind is sufficiently pliable that basic motives are often masked, even from the person involved, by elaborate rationalizations. The real and the unreal, the true and the untrue are inextricably intertwined. The depressing fact is that the behavioral sciences have no ready means of probing motivations or of sorting hierarchies of values to determine which are held in their own right and which serve merely as cloaks for others. Thus, the extent to which projects enable us to realize important extramarket values, as opposed to masked self-interest, is, for the moment, unanswerable, at least in precise terms. In the following part, however, we will consider means by which more attention, of a rational and analytical sort, can be brought to bear on the problem of extramarket values.

VI

SHOULD ECONOMIC EVALUATION BE ABANDONED?

If the analysis presented in the foregoing sections is valid, economic evaluation is failing in its purpose, which is to aid us in the rational comparison of alternatives. The repayment requirement of reclamation law has been administered in such a way that project beneficiaries are required to repay capital costs only to the extent of their "ability." Since the standard is not an absolute one, despite the requirements of the law, it loses much of its value as a measuring rod, although admittedly it may be of some use in weeding out the least efficient projects—especially if they have comparatively little political support. Much the same has happened to benefit-cost analysis. If our analysis is correct, this form of economic evaluation has been corrupted by counting secondary benefits during periods of full employment and by the excessively optimistic estimation of direct benefits. All the agencies seem guilty, and one can only conclude that political pressures, interagency competition, and bureaucratic self-interest dictate that enough favorable ratios be "found" each year to keep the several programs going at a "desirable" level of activity.

The question must then be asked: Should economic evaluation be abandoned

[36] HUFFMAN, *op. cit. supra* note 15, at 180.
[37] See de Roos and Maass, *The Lobby that Can't Be Licked*, Harper's Magazine, Aug. 1949, p. 21.

because it is misleading and does more harm than good? Wantrup has asked this question and answered it in the negative. He argues first that "economic and pseudoeconomic arguments are by far the most important weapons in the arsenal of opposed regional, industrial, and occupational interests contending in the political arena for or against a public project," and that benefit-cost analysis in the hands of the Government "serves a worth-while purpose to restrain the abuse of economic arguments in the political process."[38] The facts, however, point in the opposite direction. Governmental calculations of benefits and costs cannot be used to restrain the abuse of economic arguments, because these calculations are themselves unreliable and misleading. In fact, it seems fair to say that government agencies contribute nearly as much to the abuse of economic arguments as do private interests. Perhaps the net effect of benefit-cost analysis by government agencies is to undermine public confidence in the arguments of those who attach little weight to extramarket benefits and hold that many projects should not be constructed because they are uneconomic. This defense of benefit-cost analysis, then, seems untenable.

Wantrup's second defense of benefit-cost analysis is that it is worthwhile "because of its stimulating effects in expanding scientific understanding of the physical as well as social problems in public resource development."[39] In support of this position, he argues that the persistent quest of those who calculate benefit-cost ratios for additional quantitative information has stimulated research in the physical problems of flood control, reclamation, and land management. One can grant this argument, however, without agreeing that the benefits to the physical sciences are worth the price we pay through the misinforming of decision-makers. As for the social sciences, it is probably true that benefit-cost analysis has focused attention on the decision-making process and on the factors which play a role in it. The development of a small, but growing, literature on the subject is evidence of that. But its more general and important effect is to narcotize any real public interest in project evaluation. The symbols of the market economy are so powerful in America that the public is soothed into near unconsciousness when told by an authoritative government agency that the returns from a project will exceed its costs.

Must our question, then, be answered in the affirmative? I think not. Fortunately, the abuse of economic evaluation by government agences does not, by itself, lead to the construction of *many* projects. The political forces at work are such that most projects would probably be authorized in any event, although the process might be a bit more embarrassing in the absence of the appearance of respectability which economic evaluation provides. But the positive case for economic evaluation rests on the enormous contribution which it *could* make to the decision-making process and, through it, to rational social action. Properly conducted, economic evaluation can provide a valuable comparison of alternatives in terms of those direct benefits and costs which can reasonably be reduced to dollar values. And if, as seems likely,

[38] Wantrup, *supra* note 9, at 677.
[39] *Id.* at 678.

many of these ratios were near or below unity, this fact would focus attention on much of the loose justification of projects in terms of their extramarket values. One could reasonably expect that alleged benefits such as "the psychological value society derives from the development of a region," creating settlement opportunities, and harnessing untamed rivers would be subjected to far more searching scrutiny by the public and by decision-makers in particular than is the case now, when padded ratios lull us into a false sense of security.

If the case for economic evaluation rests upon its enormous potential contribution to rational decision-making, how can it be made to fulfill its purpose? The answer is fortunately simple: effective control under a strong unit in the Executive Office of the President. Such a unit must be wholly independent of the construction agencies, and it must have the power (1) to establish standards and procedures for economic evaluation, and (2) to audit the working papers of agency economists and physical scientists in the field. Human nature and political pressures being what they are, the construction agencies cannot be trusted to produce objective economic evaluations. Action to provide an independent check on the construction agencies could quite probably be taken under presidential authority alone.

American political arrangements are such that most units in the Executive Office of the President are not wholly free of political pressure. The unit suggested above would unquestionably be even more free to pursue its assigned task if Congress were willing to enact legislation to require that direct beneficiaries of all water development projects return a substantial share of project costs to the federal treasury. The repayment requirements of reclamation law, to some extent, eliminate pressures for construction of the least economic projects. The extension of a similar requirement to navigation and flood-control law could hardly help but have a sobering influence on those who now press for utterly uneconomic programs of water resource development.

THE POLITICS OF RIVER BASIN DEVELOPMENT

NORMAN WENGERT*

Many articles in this symposium deal with particular river basin problems and their solutions and with substantive issues and programs. The present article, however, is concerned with certain characteristics both of the process by which problems are identified and solutions chosen and of the environment within which these identifications and choices are made. Its focus is not on decisions, but on decision-making and on the factors and forces influencing decision-making. This is the political process.

Descriptions of public or governmental decision-making frequently indicate a strong rationalist bias—an assumption that decisions are largely the end-product of logical analysis and rational calculation, or at least that they should be. As will be indicated later, this attitude is especially prevalent in the discussion of natural resources policies and programs. In this context, of course, the term *politics* has a sinister connotation and symbolizes irrational, selfish decision-making. It is only man's perverseness and corruption that stand in the way of better, more logical techniques for determining public policy and force the use of political processes for making public-governmental decisions. And these processes are regarded as undesirable and inferior ways for making second-best choices. This view is here rejected.

I

POLITICS DEFINED

As used in this article, the term *politics* denotes the total process by which public-governmental decisions are made—decisions involving the selection of governmental means as well as ends, decisions determining the problems of government as well as the techniques for dealing with them. This view of politics recognizes that many factors and forces, concepts and circumstances, values and beliefs, ideas and myths, influence the character and direction of public-governmental decisions. The issues themselves, the manner in which they are drawn, the participants, their goals and values, together with the structure, mechanisms and techniques, procedures and practices of government—all are elements of the political process. All are comprehended in the term *politics*.

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[1] The concept of the political process here summarized is dealt with somewhat more extensively in NORMAN WENGERT, NATURAL RESOURCES AND THE POLITICAL STRUGGLE (1955), which also contains relevant references.

In part, the process relies upon logical analysis and rational calculation; in part, upon judgment, informed guess, and hunch; and in part, upon compromise, negotiation, bargaining, conflict, and struggle.

The end of the political process is the public interest. Yet, the determination of that interest is no simple matter. Hence, a major task of the process itself is the clarification and definition of the public interest. It may well be that at some future time, mankind and governments will know enough to make social value choices entirely by nonpolitical means. But borrowing Madison's figure of speech, the view of this article is that till angels govern men, the political process, as here described, will continue to be the way in which public-governmental decisions can best be made. This is not a matter of irrationality, or corruption, or second-best choice, but of designing a process which includes within its ken the diversities of democratic life and which permits a constant examination and re-examination of values and goals, methods and techniques. The political process is, thus, regarded as necessary for refining and clarifying objectives, for permitting countervailing forces to organize and operate, and for ultimately arriving at working definitions of the public interest.

In this view, politics is a kind of market-place process in which trades and negotiations take place as individual, group, and community interests are weighed against each other, costs and benefits assessed, and choices made. Like the market place of the economists, the political market place is also concerned with allocations, not of resources directly, but of power, authority, and influence over the affairs of government. It, too, presents a picture of imperfect competition, for inadequate knowledge, power imbalances, and other impediments create frictions and distortions. And like the process of the economic market, the political process often appears confused and illogical, rather than neat and systematic. Like the concept of the economic market, too, this concept of politics accepts the limitations of man's ability to foresee the future, to consider all relevant factors, to account for all effects. It denies the present ability of any man or group of men to define for others with finality either individual or public interest, emphasizing the diversity in values and the difficulties in separating out the tangled threads of self-interest from those of public interest. This is, of course, the traditional view of the democratic, open society, based upon manifold potential choice and free will. It implicitly challenges monolithic conceptions of public policy which underlie most closed philosophic systems.[2]

From this pluralistic view of politics and the political process, moreover, several summary propositions may be derived. The first is that points of decision are many, scattered through the government structure and outside that structure but vitally

[2] The term "policy" is often used with a sense of static finality that divorces it from its relation to "politics." Policy decisions, it is implied, lead to stability. Having once decided policy, those concerned could then proceed to the next order of business and get some work done, so the argument goes. This view of policy seems to assume superior knowledge in particular decision-makers or to require overriding of divergent interests and conflicting values, instead of emphasizing the continuous, ongoing character of the political struggle. For a discussion of policy which takes a divergent view from that here suggested, positing a water policy that would be "a clear, accepted, reasonably stable body of principles," see Ackerman, *Questions for Designers of Future Water Policy*, 38 J. FARM ECON. 971 (1956).

related to it. As a result, politics and the political struggle are pervasive aspects of government. The second is that groups are dominant participants in the process, a group being simply a collection of individuals organized to act in concert for some agreed-upon purpose. The third is that struggle, competition, bargaining, and negotiation are characteristic of the ongoing process, reflecting the complexity of individual and group goals and the continuous action and reaction, alignment and realignment of factors and forces.[3] And finally, decisions occur in context, or, to use Gaus's phrase, government takes place in an ecological setting.

The definition of politics and the political process outlined in these paragraphs offers a conceptual framework for selecting and analyzing data on the politics of river basin development. Space, however, does not permit a systematic and comprehensive application of these concepts to river basin development in this article. In any case, a number of detailed studies of particular basins are available which deal with some of these political forces,[4] and other articles in this symposium touch on particular aspects of river basin development politics. The balance of this article, therefore, considers several selected and unique characteristics of the politics of river basin development for topical treatment.

II

THE IMPETUS TO RIVER BASIN DEVELOPMENT

The political process in the United States operates in response to articulated demands and felt needs. Government does not act spontaneously nor for reasons of whim, but rather because some individual or some group wants something and has instigated action seeking decisions favorable to that position. In this part, some of the interests and forces that give impetus to river basin development will be considered, and some of the groups involved will be examined.

For over fifty years, an articulate group of men-of-good-will has been attracted to the idea of the river basin as a logical and proper basis for resource development. Their interests have been conservation, wise use of resources through positive, dynamic governmental action for what they considered to be the public good. Professor Samuel Hays suggests that for this group, the idea of rational management of the nation's resources was an important goal.[5] And undoubtedly this goal continues to

[3] The literature on the group basis of politics is extensive. Among the more important works are: DAVID B. TRUMAN, THE GOVERNMENTAL PROCESS (1951); EARL LATHAM, THE GROUP BASIS OF POLITICS (1952); and BERTRAM M. GROSS, THE LEGISLATIVE STRUGGLE (1953).

[4] The most written-about basin is the Tennessee, although few of the studies deal explicitly with the political forces involved. For references, see TVA, AN INDEXED BIBLIOGRAPHY OF THE TENNESSEE VALLEY AUTHORITY (1936) (cumulative supplements issued annually). Also extensively treated is the Missouri. *E.g.*, RUFUS TERRAL, THE MISSOURI VALLEY (1947); RICHARD G. BAUMHOFF, THE DAMMED MISSOURI VALLEY (1951); MARIAN E. RIDGEWAY, THE MISSOURI BASIN'S PICK-SLOAN PLAN (1955). Other basins have been less thoroughly reviewed, but note should be made of CHARLES MCKINLEY, UNCLE SAM IN THE PACIFIC NORTHWEST (1952), and that classic study, ARTHUR MAASS, MUDDY WATERS: THE ARMY ENGINEERS AND THE NATION'S RIVERS (1951). The periodical literature on basin development is extensive, and the government publications overwhelming.

[5] SAMUEL P. HAYS, THE FIRST AMERICAN CONSERVATION MOVEMENT, 1891-1920 (unpublished doctoral dissertation in Harvard University Library 1952).

draw support for river basin development from those who value systematic resource management.

This viewpoint tends to assume that development is good (thus, really begging the whole question) and focuses attention on the type of development and the organizational forms for carrying on that development. To this point of view are drawn public-spirited citizens, conservationists, and others who seek the good of the community and find what appears to be a scientific reasonableness in river basin development. As suggested below, this position, which begins from logical enough premises, is often converted into a complex structure of myths and symbols effective in rallying public support and in providing a convenient rationale for individual values and more specific interests of various kinds.

In many river basins, acute economic problems and the hope that they might be dealt with more effectively has proved an important stimulus to programs labeled basin development. For instance, the concern of Senator Kerr over the economic well-being of his state and of the Southwest led to the five-year Arkansas-White-Red River Basins Survey.[6] Similarly, in the northern Great Plains, the problems of drought and flood, of agricultural surpluses, of population losses and industrial underdevelopment have given to proposals for Missouri basin development (especially as symbolized in the Pick-Sloan plan) an attraction that individual project proposals never had. It matters not that the basin plan is only dressed in the language of areal unity and regional development and that the practice remains largely the practice of separate function and particularized responsibility. The important element is the hope that somehow this program of development will result in solutions for some of the problems now plaguing the region.

The increased interest in river basin development in New England[7] reflects the recent major floods in that area. But here, too, basic forces are the fact that the economy is declining (relatively) and the hope of revitalizing it. Together, these forces may finally be sufficient to overcome the strong antigovernmental biases of the region and lead to expanded federal programs in the area.

And historically—and even to the present—economic improvement has been a major factor in the formulation of the Tennessee Valley program; and in the formative years of that program, it was obviously more significant than loyalty to the particular agency, which today bolsters support of the regional program.

In addition to support for basin development which rests on such more-or-less

[6] Authorized by the Flood Control Act of 1950, §205, 69 STAT. 186, 33 U.S.C. §701n (1952). For additional material on this subject see IRVING K. FOX AND ISABEL PICKEN, THE UPSTREAM-DOWNSTREAM FLOOD CONTROL CONTROVERSY IN THE ARKANSAS-WHITE-RED BASINS SURVEY (1957).

[7] New England, like the Arkansas-White-Red River region, is not a single river basin. Rigorous logic would perhaps require a definition of the term "river basin." Yet, the fact is that the term is used very loosely and, as is suggested *infra*, gains political significance from this very fact. In many cases, river basin development is equivalent to river development as this may be defined by the particular group, agency, or individual using the concept. At the same time, emphasis on the basin is usually meant to connote a broader-gauge, more inclusive approach to river problems and is often considered equivalent to a "regional" approach. But the literature on regionalism is not at all agreed on the definition of the region and even less on whether a river basin is a sound and proper regional unit.

vague yearnings for a solution to pressing economic problems, further impetus to river basin development programs or segments of programs comes from numerous special interests that will benefit or think they will benefit from particular development activities. Included in this group would be: contractors expecting construction work, together with their host of suppliers; chambers of commerce and labor unions anticipating bigger payrolls; shippers wanting water navigation or lower railroad rates; sellers of irrigation equipment; etc. And it should be noted that much of this stimulus is utterly sincere, though perhaps misguided, based in part on the necessity each of us feels to believe in the importance of what he is doing and in the desire to do more of the same.

Key elements in the support picture are the government agencies with particular programs to sell—flood control, irrigation, watershed protection, public power, etc. Here, incidentally, one of the consequences of the functional approach to government organization is apparent, for the mandates of most agencies (the TVA is a possible exception) are not to develop a region or a basin, but to prevent floods, save the soil, irrigate the land, protect the forests, etc. The result is often mere use of river basin development terminology because it is expedient and gains public support, without really adjusting programs to regional development criteria.[8]

Allied with the government agencies are numerous local groups and interests (including traditional political parties), the nature and motivation of their support of river basin development presenting a broad range. The strong local support for flood control in the communities affected by floods is well known, as is the fact that much of this support stems from dubious economic policies and drives which permit most of the costs of flood control to be passed on to the federal government, with the local community seeming to get something almost for nothing.[9] Local support for navigation works is often similarly based. In fact, of course, it is difficult to generalize, each basin, even each project, presenting a different combination of factors, and motivations being complex and variegated.

It seems obvious, too, that the many forces and factors which give impetus to river basin development are not necessarily in harmony with one another. At the same time, lack of consistency does not always result in conflict, for plural administration in a plural society encourages plural programs and policies. And the language of river basin development may suggest a specious unity of purpose and program.

In fact, mechanisms and institutions for clarifying conflicts and permitting choices with respect to the goals of river basin development are weak and inadequate. Where conflict over goals develops, pressures of various sorts push in the direction of expedient accommodation of many interests and issues (*e.g.*, the Pick-Sloan plan),[10]

[8] The administrative aspects of this problem are explored in JAMES W. FESLER, AREA AND ADMINISTRATION (1948).

[9] Numerous recommendations have been made in recent years urging that beneficiaries should pay for more of the benefits, but little progress in this direction has been made, and it seems doubtful that changes in this respect will be forthcoming.

[10] For a discussion of this plan, see RIDGEWAY, *op. cit. supra*, note 4.

rather than resolution of conflicts and clear decisions on goals and objectives. A prime value is to avoid stalemate so that programs (as well as debate) can continue, consistent with the attitude that everybody benefits from basin development.

It might be noted, moreover, that neither the causes of the problems nor the proposed solutions need be based upon close analysis and logical reasoning. The support for river basin development arises, rather, from the belief that such development offers a solution to problems, the reality of which cannot be denied, even if the causes are not understood.

III

PARTICIPANTS AND ISSUES

While participants in river basin development have been generally characterized in the preceding section, it should be noted that participants are functions of the issues and problems arising in particular basins. And within each basin, to a large degree, the combination of issues and participants is unique. This suggests the need for a case-by-case examination, which is not feasible in this article. Some of the typical issues can, however, be mentioned to suggest the nature of this aspect of the political struggle.

Controversies over water allocation have been especially frequent in the semiarid West. Disputes over the allocation of costs and benefits among upstream and downstream, rural and urban, local and national interests are common. With respect to flood control, the debate over high, low, or no dams continues, complicated by considerations of the role of land-use management, diking, and flood walls. Disputes over program priorities have also arisen but rarely in a form that has permitted clear-cut decisions.

Overshadowing all other issues, however, has been the issue of hydroelectric power. Unquestionably, if this question had not been associated with river basin development, the political struggle over such development would have been much different. The conflict over hydroelectric power has most often been thought of in oversimplified terms of public versus private power. Actually, more complex questions are frequently involved, including:

1. the extent to which maximum power production should be an objective of river basin development;
2. the pattern of financing and, in multipurpose projects, of cost allocations;
3. rate or charge policies, including questions of taxation, tax equivalents, and rate of return on the public investment;
4. whether a federal agency should have a utility responsibility to provide power within a given area, expanding production by thermal generation when necessary to meet growing load demands;
5. transmission and/or distribution policies, including the question of preference customers; and

6. an overriding question of regional economic development as a federal responsibility.

These issues are too complex to examine in this article, but it should be noted that while it is relatively simple to catalogue them, it is next to impossible to characterize and classify the participants in the controversy. The temptation to oversimplify must be avoided.

The privately-owned electric utilities are usually identified as opposed to certain aspects of public power policy. But while at one time their position was hostile to all public development, they have, in many areas, qualified their stand and now seem to object primarily to public transmission and distribution policies which cut into monopoly markets. Their preferences are, thus, for partnership policies which stress sale of governmentally-generated energy to existing (and usually adjacent) utility systems. In general, these preferences are consistent with the power policy inclinations of the Army Corps of Engineers, which has not been noted for a vigorous pro-public power position. Thus, supporters of the corps program and supporters of private power interests are often in alliance.[11]

Beyond these simple participant relationships, however, alliances and alignments become complex and confused, requiring detailed examination of economic, geographic, and ideologic interests to determine patterns of relationships. And often the connection between the position on power development and river basin development is subtle and obscure.

IV

MYTHS AND SYMBOLS

In a democratic, open society, which generally demands a high degree of group support for public-governmental action, the use of evocative symbols in order to communicate with the general public is normal, if not necessary and inevitable. The point at which communication becomes manipulation is not considered here. But it seems axiomatic that in order to convey meaning to the mass of citizens and to mobilize support for goals and ideals, connotative, symbolic language is indispensable. It is noteworthy, too, that ideas and concepts which in origin may have precise, scientific meaning often, in the process of political communication, take on elaborate symbolic overtones and become part of a complex myth structure.

Besides being important to political communication, however, myths and symbols may also provide convenient rationalizations for particular interests, values, and goals. In either case, the articulation and use of myths and symbols may be deliberate and

[11] MAASS, *op. cit. supra* note 4, at 188 *et seq.*, discusses corps policies and attitudes on the public power questions. The reader interested in sampling the variegated interest structure is referred to *Hearings Before a Special Subcommittee of the House Committee on Government Operations*, 84th Cong., 1st Sess. (1955), dealing with the U.S. COMM'N ON ORGANIZATION OF THE EXECUTIVE BRANCH OF THE GOVERNMENT, WATER RESOURCES AND POWER (1955) (second Hoover Commission Report). These hearings, held over several months in various parts of the country, cover over 2900 pages of printed testimony and evidence reflecting the complex of interests and positions.

contrived, or unconscious, automatic aspects of human intercourse. Their use may be evidence of a propaganda effort or reflect the sincere convictions of those involved. In any event, myths and symbols play an important role in the political process and must be carefully analyzed and appraised. The following paragraphs examine some of the myths and symbols that have become identified with river basin politics.

Perhaps one of the most potent symbols of river basin politics (and of resource politics generally) is the concept of *development* itself. By this term, whether applied to particular resources, to water projects, or to an entire river basin, are evoked a host of images and favorable responses, ranging from pictures of the desert blooming, with yeomen farmers tilling it, to active waterway commerce and industrial expansion giving new life to the economy of the basin. Of course, Americans want to develop their resources, their river basins. No one can effectively oppose development;[12] to resist amounts almost to subversion. Yet, the very term *development* begs the questions of how much, by whom, when, at whose expense, and for whose benefit. It says nothing about what development means nor how it can be achieved. It is, in short, a twentieth-century counterpart of the "boomer" attitudes of the last century, which led to the disposal and settlement of the public domain, the harvesting of the forests, and the promotion of resource utilization generally.

The wisdom of hindsight has led to serious question whether the policies of that earlier period were entirely sound. And it should be noted that the policies followed were not without criticism and objection. But critics and objectors were overwhelmed by "boomer" enthusiasms which carried the day. Whether current stress on development may appear in hindsight to have been ill-conceived remains to be seen; but the parallel is sufficiently clear to be disturbing.[13]

A somewhat more subtle mythology has grown up with respect to water availability. In the subhumid and semiarid West, the absolute scarcity of water has always given an urgency to water supply which, until recently, was foreign to the more humid parts of the nation. But in the last decade, these areas have encountered a variety of water problems, and a strong tendency has developed to approach these humid-area water problems in western terms. Problems that have their roots in inadequate municipal planning, engineering, or financing are publicized and discussed as analogous to the traditional problems of the West. Difficulties that have been created by plenitude and low cost of water, such as profligate use, are dramatized in terms of a desert economy. Thus, a myth develops that America has a single water problem, that the water supply is running out. It is obvious that the political impact of this myth of oversimplification may be, and is, of considerable importance.

Allied is the mythology that is developing with respect to water pollution. Here,

[12] In the bitter fight over whether to establish a Missouri Valley Authority, the *level* of development was not at issue, nor was it suggested that the MVA program might mean a lower level of development expenditure. The controversy was over the control of development, not its scope.

[13] A significant study of the impact of "boomer" psychology on public policy is WALLACE STEGNER, BEYOND THE HUNDREDTH MERIDIAN (1954).

the symbol of the pristine, sparkling mountain brook is portrayed as the proper goal of public policy, no matter what the engineering problems, no matter what the cost, and often no matter what the facts as to causes and cures.[14]

Particularly difficult to analyze is the myth that envelops many resource policy questions and river basin questions in particular. This is the myth that decisions in this area of policy are simply questions of science and engineering—that only physical standards and criteria are relevant to sound decisions. The explanation of this situation is not hard to find. From the beginning of the conservation movement, some fifty years ago, many of its active leaders were engineers and scientists. And members of these professional groups continue to play important roles in the formulation of resource policies. Their values are conditioned by their professional backgrounds (which is natural), and they often share a Platonic dream of a rationalized world in which public decisions would be made by philosopher-kings, who, in the field of resource policy, would undoubtedly be engineers and scientists.

The resultant belief that in these technical skills lies a solution to political conflict is evident, for instance, in the current proposals for a Board of Review as the final top-level authority in the field of water policy.[15] To assume that economic choices and social values can thus be disciplined or submerged is to mistake the real character of the forces that lie behind river basin politics. To follow such a course, moreover, may merely divert the struggle to another point of decision. And if this is the objective, then the analyst must determine, among other things, whether the result removes the decision farther from public scrutiny and control, whether it deters the operation of the countervailing forces which are vital to the democratic processes of decision.[16]

Uniquely important to the politics of river basin development are the myths and symbols that have grown around the idea of the river basin as an appropriate unit for development programs. For many years, certainly into the 1920's and still today, a dominant interest in rivers was not the basin as such, but particular projects, individual activities, isolated functions. The issues of what action government should or should not undertake with respect to particular rivers involved intense political struggle. But these issues were initially seldom drawn in terms of the basin and its development. This was water politics, not strictly basin development politics.[17] The two are, of course, closely related, for river basin development includes water

[14] The attitudes on pollution are reflected in *Hearings Before a Subcommittee of the Senate Committee on Public Works on S. 890 and S. 928*, 84th Cong., 1st Sess. (1955), and *Hearings Before the House Subcommittee on Public Works on S. 890 and H. R. 9540*, 84th Cong. 1st and 2d Sess. (1955 and 1956).

[15] This has been the position articulated in NATIONAL WATER POLICY PANEL OF THE ENGINEERS JOINT COUNCIL, PRINCIPLES OF A SOUND NATIONAL WATER POLICY (1951).

[16] Those concerned with government organization and structure often overlook the importance of relating points of decision to the desirability of full and free political struggle. Criteria for governmental organization involve not only questions of social psychology in the relation of supervisors to supervised; they also involve questions of providing for the effective play of political forces in the decision-making process.

[17] A history of comprehensive water development may be found in 3 PRESIDENT'S WATER RESOURCES POLICY COMM'N, REPORT c. 9 (1950).

development. The significant distinction lies in the broader scope of river basin development and the symbolic overtones of such a broader approach. A brief survey of the evolution of ideas with respect to the river basin is suggestive of the way in which myths and symbols grow.

At the turn of the century, a new interest in using the rivers of the nation for navigation was evident. The burgeoning electric power industry was scrambling for hydroelectric power sites, while in western states, clamor for irrigation resulted in injecting the national government into this phase of water use. At the same time, a new stimulus to flood control in the lower Mississippi and increasing urbanization in other areas set the stage for a growing concern over flood losses and water supply.

Since these several interests frequently involved the same river, the reasonableness —even necessity—of considering interrelationships in the entire system seems obvious. When engineering techniques advanced to the point where it was possible to construct a large power dam, its relationship to navigation and flood control (and irrigation in the West) was perceived. Hence, concern for multipurpose projects was a logical progression. Similarly, the interrelationships among projects in a single river system was a natural result of more intensive development of particular streams. And intensive development of a particular stream directed attention to the uses of the water, power, and other benefits. But while the imperatives of topography, hydrology, and engineering led logically to a coordinated approach to water development, such an approach might still be considerably short of what is today included in the concept of river basin development.[18]

In his autobiography, Gifford Pinchot tells how the concept of resource interrelationships and basin unity came to him and was developed and elaborated by his co-worker, W. J. McGee. To the latter, he attributes the language which President Theodore Roosevelt incorporated in his letter establishing the Inland Waterways Commission in 1907, stating:[19]

> It is not possible to properly frame so large a plan as this for the control of our rivers without taking account of the orderly development of other natural resources. Therefore, I ask that the Inland Waterways Commission shall consider the relations of the streams to the use of all the great permanent natural resources and their conservation for the making and maintenance of prosperous homes.

It is the progression from mere water development to the development of all resources that distinguishes a river basin approach and that gives to it its great symbolic appeal.[20] Thus, the watershed is visualized as an organic whole, having peculiar, often mystical unifying characteristics. The river basin region is, consequently, regarded as offering a logical basis for economic development, which is

[18] Limitations of data, inadequate technology, or merely a narrow focus of responsibility should not be equated with an unawareness of the physical relationships in an entire river.

[19] Inland Waterways Comm'n, *Preliminary Report*, S. Doc. No. 325, 60th Cong. 1st Sess. iv (1908). See GIFFORD PINCHOT, BREAKING NEW GROUND 328 (1947).

[20] So compelling is this symbolism of the basin that Senator Kerr found it useful to secure a study of the three rivers that affect his state, the Arkansas, White, and Red Rivers. *Cf.* note 6 *supra*.

contrasted with the alleged inappropriateness of traditional political boundaries. In much of the discussion, these naturalist overtones are related to ideas of the balance of nature, of the necessity of acting in harmony with the demands of flowing water. Thus, basin development comes to be linked to elemental life processes.

The chain of reasoning which gives an essential unity to the river basin, not alone for water programs, but for total development, leads, in this argument, to the necessity of planning unity. And the entire conceptual structure is bolstered by heuristic and hortatory phrases like "comprehensive," "multipurpose," "integrated," "unified," and "balanced." Economic and general development are associated with river development, and the watershed is assumed to be a proper and effective unit for government planning and action.

Certainly, no one can argue for disunified, uncomprehensive, uncoordinated, disintegrated development. But these are not the logical alternatives. Yet, stating them pinpoints the tremendous impact of the symbols[21] and emphasizes the difficulties of penetrating to the real issues of costs, benefits, alternatives, and consequences. One result of this may be that the political struggle occurs over the wrong questions; for, myths and symbols, especially when they possess an aura of rationality and reasonableness, can be effective diversionary devices, used to increase and preserve power, prestige, and advantage. By cutting off analysis and criticism—and it is recognized that the precise line between valid criticism and destructive attacks on essential values is not always easy to draw—myths and symbols can provide a convenient and secure façade for individual, group, and community or regional benefits presented in terms of a larger public good.

Other myths and symbols of importance to the politics of river basin development are suggested by terms and phrases like "valley authority," "private enterprise," "partnership policy," and "the power in the river belongs to the people." Each of these and many others require sophisticated analysis if the political struggle over river basin development is to be understood. But it is only possible to mention them here to indicate the complexity of the myth and symbol structure.

V

THE POLITICS OF SPACE

The river basin is, by definition, a unit of space. And, as suggested above, the idea of river basin development has had a strong popular appeal because of its implications of areal unity and integrity, especially when contrasted with an alleged atomistic approach based on single purposes or single projects. From such an idealized portrayal of river basin unity, it has often been assumed that areal integrity eliminated politics, unity being equated with harmony. This assumption

[21] The hostility of so-called "regional scientists" to the river basin as a proper unit for regional development and specifically to the Tennessee watershed is reflected in that still important study, NATIONAL RESOURCES COMMITTEE, REGIONAL FACTORS IN NATIONAL PLANNING 146 (1935). Yet, the validity of these criticisms of the basin approach has been largely forgotten in the ensuing years, because, in my opinion, of the symbolic appeal of the basin approach.

rested upon a belief that a river basin development program necessarily was the equivalent (if not the acme) of a rational, calculated plan of action, and as such, conflict or controversy, choices or value differences were irrelevant and improper.

In fact, however, spatial aspects of river basin development have involved intense political struggles. The issues of boundaries, the conflict among upstream and downstream interests, the reconciliation of urban and rural hostilities, and the difficulties that have arisen because of the absence of a forum for political discussion and decision are illustrations of some of these spatial factors.

River basin boundary politics have involved relations with contiguous areas as well as conflicts within the basin itself. They have raised questions of intergovernmental relations and states' rights and have encouraged struggles among competing bureaucracies for power, prestige, and especially for appropriations. Only a few of these can be referred to here as typical.

First, is the question of what river system is to provide the boundaries for the basin. This is the problem of drawing regional lines. No one has seriously proposed using the Mississippi watershed as the unit for basin development. Yet, this rejection implicitly raises the question of why the Missouri should be and the Ohio should not be the basis for development programs.[22]

So long as development is limited to navigation and local flood works (the traditional programs of the Army Corps of Engineers), no serious conflicts over basin boundaries arise. But add hydroelectric power, flood-storage reservoirs, irrigation, and broader development programs, and the struggle for inclusion or exclusion becomes intense. And once boundaries for development have been chosen, the basin does take on a degree of unity with respect to other sections of the country. The very process of choosing is aided because basin boundaries are set by nature and, thus, carry an aura of determinist superiority over boundaries set by administrative or political fiat. This the TVA learned as it retreated to its natural boundaries with respect to all of its activities except power distribution and fertilizer research and development.[23]

The controversy between upstream and downstream interests has taken several forms. In the Missouri basin, where substantial environmental, cultural, economic, and other differences serve to set upstream off from downstream areas, disputes over whether scarce water should be used for upstream irrigation or downstream navigation have been bitter. Participants took sides as between the Bureau of Reclamation and the Army Corps of Engineers in this dispute.[24]

[22] And, one might ask, why three basins should be considered appropriate for development: the Arkansas, White and Red River basins. See note 6, *supra*.

[23] The TVA Act had wisely provided that TVA programs might include contiguous areas, but pressures of various sorts confined most of the TVA programs to the watershed, whether or not this was logical from the viewpoint of the program. Among the important pressures in this situation were competing federal agencies. In this connection, see NORMAN WENGERT, VALLEY OF TOMORROW: THE TVA AND AGRICULTURE c. 8 (1952).

[24] The conflicts were not resolved, although their intensity was reduced by the Pick-Sloan plan, which critics generally deride as no solution, and by additional hydrological data which seemed to indicate that water supply might be adequate for both upstream and downstream requirements.

A variant of this controversy has been that between urban and rural interests over flooding of agricultural land by reservoir construction to protect downstream cities from floods or provide them with power. Except where storage reservoirs are built in uninhabited, isolated regions, this conflict seems universal. It reached particular vehemence in Kansas, where reservoirs to protect Kansas City would have flooded high-value farm lands.[25]

In the case of power and consumptive uses of water, the struggle over who shall get the power or water has frequently been intense, but the solution to these conflicts has often been less than creative. Water allocation agreements (compacts) among riparian states are common, but their underlying philosophy is sterile, emphasizing legalistic rights to given quantities of water, rather than determinations of public interest in water use and optimum development. Following the pattern with respect to water, states have also sought to control hydroelectric power produced in or generated by water falling within their boundaries. Thus, for example, North and South Dakota resist sale of Missouri River energy in Minneapolis; and North Carolina has expressed some dissatisfaction over the distribution of TVA power in downstream states. Fears of Idaho that Columbia River power, generated in Idaho headwaters, will benefit the sea coast metropolitan complex is said to be one of the factors in the Hells Canyon controversy.[26]

This general issue of who benefits from river basin development has recently taken on a new slant in connection with the recently authorized small watershed program of the Soil Conservation Service.[27] Here, major disputants are two bureaucratic power groups—the United States Department of Agriculture on the one hand, and the Army Corps of Engineers on the other. Partly involved are technical questions regarding the significance of land management for flood control. But the steady accumulation of hydrologic data over the past twenty years has resulted in a retreat on the part of the agriculturists from the extreme positions that once were asserted, when floods were largely blamed on bad land use.[28] But while most bureaucrats have adjusted their positions to newer and more reliable data, enthusiasts and partisans continue to make exaggerated claims that if we just manage our soils properly, floods will be eliminated and at a fraction of the cost of dams and levees.[29]

In many cases, the crux of the small watershed controversy is the fact that upstream land management with small control structures (as encouraged by the SCS) may have a sufficient impact upon smaller, more frequent floods, while, at the same time, leaving downstream urban centers victims of the larger, less frequent floods.

[25] This was the Tuttle Creek Dam.

[26] See Bessey, *Political Issues of the Hells Canyon Controversy*, 9 WEST. POL. Q. 676 (1956).

[27] Watershed Protection and Food Prevention Act of 1954, 68 STAT. 666, 16 U.S.C. §§1001-07 (Supp. II, 1955).

[28] The shift in views on this is clearly reflected in MISSOURI BASIN SURVEY COMM'N, MISSOURI: LAND AND WATER 124 *et seq.* (1953). See also the definitive study by LUNA B. LEOPOLD AND THOMAS MADDOCK, JR., THE FLOOD CONTROL CONTROVERSY (1954).

[29] For this point of view, see Farb, *A Flood Prevention Plan*, 65 NAT'L MUNIC. REV. 214 (1956); see also Peterson, *Big-Dam Foolishness*, Reader's Digest, July 1952, p. 63.

In consequence, the economic basis for any flood works in the towns and cities, as presently calculated by cost-benefit formulas, may be destroyed.[30]

Of a different character have been the political space problems raised by the lack of coincidence among economic, administrative, and political boundaries with those of the watershed or river basin. The ardent advocate of basin development urges that economic and political boundaries are irrelevant. But, as has been suggested, this assumes that the watershed boundaries are reasonable and sound for general development, contrary to the facts in many cases.[31] The resulting tensions and problems are complex.

One aspect of the boundary question that has not received sufficient attention is the absence within the river basin unit or region of effective devices and institutions for raising and settling value, goal, and other policy issues. In short, the political process is stunted with respect to the river basin because there is no effective political forum for discussion and resolution of basin problems. This political-institutional deficiency can have serious consequences.

At the national level, Congress can, at best, devote only casual attention to policy questions affecting particular basins, unless, perhaps, there is a prospect of patronage dividends. And then, decisions are likely to be on the basis of bargains and trades. Most federal agencies, similarly, find it difficult to deal with basin problems in a basin perspective. To be sure, these agencies talk about river basin development, but too often this is convenient cover for an essentially functional approach. The mere fact that agencies operate in a particular basin does not give to their programs a basin orientation. The crucial distinction is, on the one hand between carrying programs to this or that region, and on the other of developing a regional program on the basis of basin needs and problems, with program content being determined by these needs and problems.

The result is that no matter how suitable a river basin may be as a spatial unit for the solution of water and other resource problems, the absence of political and administrative organizations and institutions competent and responsible for basin decisions hampers this approach. It intensifies the use of myths and symbols of basin development for protection of decisions that have not been examined in terms of regional interest and permits development decisions to be made by default—for the public cannot know what is going on in the absence of effective political struggle.

In this context, the valley authority device needs to be re-examined to determine the extent to which it may provide a more effective instrument for raising and resolving issues for political decision. It makes only tactical difference whether the regional agency is called an *authority,* after the TVA model, or a *commission,* as proposed by the Missouri Basin Survey Commission. The important test is the scope of the agency's responsibilities and its authority to deal with basin problems.

An adequate regional agency would at least provide an *administrative* forum

[30] This is well illustrated in the comparative study of alternative plans for the Salt-Wahoo basin made by the MISSOURI BASIN SURVEY COMM'N, *op. cit. supra* note 28, at 132 *et seq.*

[31] See note 21 *supra.*

for dealing with basin problems in a basin perspective. It would leave unresolved the need for an institution around which processes of representation, election, debate, and discussion might center and through which responsive and responsible decisions might be made. From the administrative point of view, it is easy to overlook the importance of those aspects of the political process which permit the political struggle to go on and which offer a correlation between responsibility, responsiveness, and control. It is essential to provide a playing field, as it were, in which contending and countervailing forces maneuver and mobilize more-or-less in the open and under public scrutiny. This is the unique role of the legislative process, and it is the absence of legislative phases of the political process which sets limits to the basin approach. For in the absence of new political boundaries, no administrative agency can alone provide an adequate mechanism for the policy choices which are involved.

VI

PLANNING POLITICS

That river basin development requires planning of some kind is implicit in the concept as such and has been taken for granted for many years. By planning is meant merely a more-or-less systematic means for identifying problems, marshalling facts, and preparing solutions so that decisions may be more deliberate and consequent. Thus defined, planning may occur at many points within the governmental structure, and its frame of reference may be very broad. It can, of course, be good or bad, effective or ineffective. Moreover, since, by definition, planning deals with the future, and since, by implication, it is often an early and major step in organizing or reorganizing power and power relationships in the context of particular objectives, an active political struggle frequently arises over who shall plan and to what ends.[32] These questions, rather than abstract issues of whether there shall be planning, are vital to river basin development. And the struggle to control planning and to determine the goals of planning is but a phase of the larger process of politics.

The idea that planning is somehow above politics because planners are assumed to be experts providing scientific answers which purport to avoid the irrationalities of pressures and interests and to resolve conflicts and struggles of politics is here rejected.[33] But it should be noted that this rejected position has been strongly held in conservation circles, where an abounding faith in supposed scientific and engineering certitude (as already discussed) has served to obscure political, economic, and social value choices. To be sure, in so far as systematic attack on problems may provide knowledge in lieu of ignorance, to that extent, planning may mitigate conflicts arising from misinformation. Planning based on logical analysis and rational calculation may also contribute to clarification of goals and an understanding of consequences. But it cannot select goals nor determine value preferences.

With respect to river basin development, a considerable amount of conflict among

[32] *Cf.* ROBERT A. DAHL AND CHARLES E. LINDBLOM, POLITICS, ECONOMICS, AND WELFARE especially pt. 1 (1953).

[33] For a more extended discussion of this view of planning, see WENGERT, *op. cit. supra* note 1, c. 1.

competing bureaucracies can be explained in terms of the struggle over who shall plan, rather than mere competition for power and advantage. The strength of the Army Corps of Engineers lies, in part, in its lack of enthusiasm for public power and its inclination to subordinate other basin programs to navigation and flood control. These biases of the Corps assure that its programs will involve a minimum disturbance to the *status quo,* for by their very nature, flood control and navigation are not likely to stir up much organized opposition at the points where the crucial decisions will be made.

In this connection, it is significant to note that pressure seems to be developing for turning the entire job of basin planning and development over to the Corps, especially in eastern basins, and a concomitant reluctance to use an interagency approach is evident. While at one time this might have meant that economic development, land-use, recreational potential, and other factors would have been ignored, it now seems to mean merely that the Corps will employ its own specialists in these fields and will fit their findings and recommendations into final plans in accordance with values and goals held by the Corps.[34]

The same type of issues, as well as others, are involved in the struggle to create a new agency to handle basin problems. One of the strengths of existing agencies, which contributes to the preference for the interagency committee approach to basin planning, lies in the fact that their objectives are known. In contrast, the planning goals of any new agency responsible for a river basin would be unknown. This uncertainty effectively stymies experimentation with new institutional devices and forces reliance upon coordinating committees, interstate compacts, and similar traditional techniques, experience with which has often been less than satisfactory.[35]

A special aspect of planning politics illustrates some of these generalizations; this is the cost-benefit situation. In recent years, Congress has usually required that benefits must equal or exceed the costs of river development works. This has caused intensive effort among water agencies to make cost-benefit studies and to refine techniques for these calculations. Yet, all who are involved in cost-benefit work readily admit numerous technical and conceptual difficulties which limit the accuracy and precision of these studies. But, as a result of the inclination of Congress to attribute a pseudocertitude to cost-benefit determinations, and because of the uncertainties in the calculations, it is not surprising that an intense struggle frequently arises over who shall do the cost-benefit calculating. The importance of controlling this phase of the planning process was indicated, for instance, in the report of the Missouri Basin Survey Commission, which reported:[36]

> While the Corps claims $11,795,000 annually as a benefit from erosion control on agricultural land, this study estimated these benefits at $964,000. . . . The total benefits are estimated at $11,096,000 compared to $26,576,000 estimated by the Corps. This makes a

[34] See MAASS, *loc. cit. supra* note 11.

[35] See the critical analysis of these devices in MISSOURI BASIN SURVEY COMM'N, *op. cit. supra* note 28, especially pt. 8; see also WENGERT, *op. cit. supra* note 1, c. 4.

[36] MISSOURI BASIN SURVEY COMM'N, *op. cit. supra* note 28, at 122.

change in the benefit-cost ratio from 1.9 to 1 as calculated by the Corps to 0.8 to 1 based on the Commission's study.

A problem in the area of planning politics which may become particularly significant in the near future is that of relating river basin development expenditures to the needs of the national economy generally and the regional economies more particularly. As yet, neither techniques nor institutions are adequate for dealing with this problem, and the political struggle has not been very active. Recognizing the important role that total public investment plays in the economic growth of the nation, the problem here would seem to be to fashion a mechanism by which the public share of total investment can be determined within limits and then allocated among the range of investment opportunities (*e.g.*, schools, highways, hospitals, parks, flood works, etc.) and among regions.

Proponents of water development sometimes argue that water development is entitled to a more-or-less fixed share of public funds or to a fixed share of the gross national product. But this approach misses the important point of the shifting character of public needs and consequent public investment. It assumes the composition of the public investment portfolio and begs the question that is of paramount importance for public fiscal policy, namely, how much water development is desirable in the context of other economic goals.[37]

Other political struggles that arise in the context of who shall plan and to what ends might be referred to, but perhaps this brief review suggests the types of forces and factors involved in this category of river basin development politics.

VII

CONCLUSION

Since its beginnings over fifty years ago, the conservation movement has portrayed basic policy issues as important, but essentially simple, choices between good and evil, between the public interest and greed and personal gain. This conspiratorial approach has characterized much of the discussion of river basin politics too. As Richard Hofstadter has suggested, this was the mood of the Progressive Era, in which the political struggle over resource policies and programs first became self-conscious.[38] And it continues to color much of the discussion of resource questions today.

To some, the pluralist approach developed in this article may verge on a kind of nihilism. Certainly, it lacks the assurance and security of pat answers and simple formulas. But it has the strength of realism, and it provides a structure within which the political struggle takes a legitimate place, rather than one for which apologies are necessary. In recognizing the diversity of values, it would seem also to avoid moral absolutism and intellectual dogmatism, providing rather for a free trade of ideas in the pattern of democratic traditions and tenets.

[37] The pressures that drive all public works programs to seek a fixed floor under their appropriations are great. The desire to secure dedicated funds illustrates this; and in this connection, the fiscal impact of the new billion-dollar federal highway aid program needs deeper analysis than it has yet received.

[38] RICHARD HOFSTADTER, THE AGE OF REFORM (1955).

In this context, then, this article will have served its purposes if it will have contributed to a broader understanding of the complex factors involved in river basin politics, if it will, to a degree, have dispelled common misconceptions as to the nature and role of the political struggle, and if it will have suggested a framework for further analysis of that struggle in the total political process.

BASIC WATER RIGHTS DOCTRINES AND THEIR IMPLICATIONS FOR RIVER BASIN DEVELOPMENT

WELLS A. HUTCHINS* AND HARRY A. STEELE†

I

INTRODUCTION

In transmitting the report of his Advisory Committee on Water Resources Policy, the President stated that "the policies we adopt for the development of our water resources will have a profound effect in the years to come upon our domestic, agricultural and industrial economy."[1] The report estimates that the demand for water in the nation will almost double by 1975 and that there must be a substantial increase in the beneficial use of water.[2] This will require increased development by individuals and corporations, as well as by public agencies.

The river basin is now generally accepted as the appropriate physiographic unit for planning and developing water resource utilization. The interrelated and competing uses of water within a river basin, however, often give rise to varied and complex problems that appear susceptible of solution only by the integrated action of all interests, public and private, within the basin's natural boundaries.[3] Thus, while group development of water resources has always been important, new impetus has been given to watershed, small project, ground-water basin, multipurpose project, and river and interriver basin programs, which appear to promise greater efficacy than development undertaken on an individual basis. State water laws, which have been framed with reference to individual action in developing water resources in the past, may not, accordingly, be adequate for the future.

In this connection, several important and troublesome areas have been pointed out.[4] The increasing consumptive use of water in the riparian-doctrine eastern states, for example, has created an interest in the appropriation doctrine as it might apply there. The shifting demand for water similarly has raised problems in the appropria-

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[1] PRESIDENTIAL ADVISORY COMM. ON WATER RESOURCES POLICY, WATER RESOURCES POLICY iv (1955).

[2] *Id.* at 5.

[3] See Steele and Regan, *Organization and Administrative Arrangements for an Effective Water Policy*, 37 J. FARM ECON. 886 (1955).

[4] See, *e.g.*, Wantrup, *Some Economic Issues in Water Rights*, 37 J. FARM ECON. 875 (1955).

tion states. A great expansion in the use of ground water, moreover, has posed problems that neither doctrine seems to answer. And large-scale multiple-purpose projects have created novel problems of reshuffling rights of use between users and uses, between watersheds, and between states.

This article will first briefly review the existing water law—the riparian and appropriation doctrines; and since most of the adjustment of these two doctrines has occurred in the western states, attention will necessarily be focused on that area. Then, it will examine some of the problems arising from the relation of these doctrines to river basin development.

II

THE LEGAL CONTEXT

A. Classifications of Water[5]

Legal distinctions between waters on the surface of the earth and those beneath the surface and between defined classes of subterranean waters have been drawn since early times. In the laws of some western states, these distinctions have been abolished, but in probably the great majority of American jurisdictions, they still persist, and so it is necessary to take account of them in discussing water rights doctrines.

1. *Surface Watercourses*

A watercourse consists essentially of a definite natural stream, flowing in a definite natural channel, and originating from a definite source of supply; and it includes the underflow.[6] The two basic systems of rights to the use of water of watercourses are related, respectively, to the riparian and the appropriation doctrines.

2. *Diffused Surface Waters*

Waters that originate from rain and melting snow and that flow vagrantly over the surface before concentrated in watercourses or before sinking into the ground are diffused surface waters—often loosely called surface waters. A considerable body of law has grown up with respect to the avoidance or riddance of such waters; much less as to rights of use. Generally, the owner of land on which such water occurs is considered entitled to capture and use it while it is still on his land. There is little authority, however, as to the relationship between such a right of capture and use and the right of a riparian landowner or appropriator on a stream into which the diffused surface water would flow if not intercepted.[7] This aspect of river basin development

[5] See, generally, 2 S. C. WIEL, WATER RIGHTS IN THE WESTERN STATES, §§1039-175 (3d ed. 1911); 2 C. S. KINNEY, A TREATISE ON THE LAW OF IRRIGATION AND WATER RIGHTS §§1148-211 (2d ed. 1912); Thompson and Fiedler, *Some Problems Relating to Legal Control of Use of Ground Waters*, 30 J. AM. WATER WORKS ASS'N 1049 (1938); Tolman and Stipp, *Analysis of Legal Concepts of Subflow and Percolating Waters*, 106 TRANS. AM. SOC'Y CIV. ENG. 882 (1941); WELLS A. HUTCHINS, SELECTED PROBLEMS IN THE LAW OF WATER RIGHTS IN THE WEST 146-265 (U. S. Dep't of Agriculture Misc. Pub. No. 418, 1942); C. L. MCGUINNESS, WATER LAW WITH SPECIAL REFERENCE TO GROUND WATER (U. S. Geol. Survey Circ. No. 17, 1951).

[6] See 1 WIEL, *op. cit. supra* note 5, §333.

[7] See HUTCHINS, *op. cit. supra* note 5, at 110-45.

may become important as more land is included in managed watersheds, but the legal principles that will govern it have yet to be formulated.

3. *Ground Waters: Definite Underground Streams*

A definite underground stream has the essential characteristics of a surface watercourse, except that it is buried in the ground. Necessarily, proof of physical aspects is difficult. Some courts insist on establishment of all elements with reasonable certainty; others accept determinations by reasonable inference. Rights to the use of definite underground streams are governed by the law of watercourses—by the riparian or the appropriation doctrines, or both of them concurrently.[8]

4. *Ground Waters: Underflow of Surface Streams*

Underneath a surface stream, there is usually an underflow or subflow. This consists of water in the sands, gravels, and other subsoil over which the surface stream flows, moving in the same direction and in intimate contact with the surface stream. The boundaries may extend laterally for considerable distances beyond the banks of the surface channel. From a legal as well as a physical standpoint, the surface stream and the underflow are not two separate rivers, but are component parts of a single watercourse.[9] Rights to the use of the underflow are governed by the law of watercourses, therefore, just as are rights in the surface flow; and rights that attach to a watercourse include rights in its underflow.[10]

5. *Ground Waters: Percolating Waters*

In determining rights of use, percolating water is usually considered to be subsurface water that is free to move by gravity and, hence, to enter wells, but not concentrated in what the law classifies as a definite underground stream or as underflow of a surface stream.[11] As in the case of watercourses, rights to the use of percolating waters fall into the two general groups: rights inherent in contiguous land, and those based on priority of diversion and use. The former group has several subdivisions: the English or common-law rule of absolute ownership, the American rule of reasonable use, and the doctrine of correlative rights.[12]

B. The Basic Doctrines

In discussing more fully the basic doctrines, to which some allusion has already been made, each of the several principal types of water rights, unless otherwise indicated, will be treated as though it were the only kind of water right in the community. Later, there will be separately considered the matter of conflicts of water rights in areas in which rights of opposing kinds are recognized.

1. *Nature of the Doctrines*

a. *Watercourses.* Where the riparian doctrine is in effect, the owner of a tract of

[8] See 2 KINNEY, *op. cit. supra* note 5, §§1156-60.
[9] See Kansas v. Colorado, 206 U. S. 46, 114-15 (1907).
[10] See 2 KINNEY, *op. cit. supra* note 5, §§1161-63.
[11] See 2 WIEL, *op. cit. supra* note 5, §1084.
[12] See 2 *id.*, §§1039-66.

land contiguous to the channel of a surface stream—called riparian land—has certain rights in the flow of the stream. He may divert what water he needs for domestic use. For irrigation and other commercial purposes, each proprietor's use of water must be reasonable with respect to the requirements of all others. The same principle applies to the ownership of land that overlies an underground stream or the underflow of a surface stream. In each case, by operation of law, the water right arises out of the contiguity of land and water supply. But a limited use of the water on nonriparian land may be permitted in some states, particularly if other riparian owners incur no present or foreseeable damage.[13] This nonriparian use may be considered an appropriation, or a use without formal right, however, rather than an exercise of the riparian right.

The appropriation doctrine, on the other hand, gives no preference to use of the water on land solely because of its contact with the water supply. Under this doctrine, the earliest right that attaches to a particular watercourse has preference over all later rights when the water supply is not enough for them all, whether the land on which the water is applied is adjacent to the stream or many miles away. This preference right is known as a priority, and the date on which the right accrues is the date of priority.[14] Needless to say, the priority of an appropriative right is, in itself, valuable property. By contrast, the riparian landowner who first begins to use water gains no preference over other riparian landowners solely because of his earlier use.

The riparian doctrine is generally followed in the eastern states.[15] Of the seventeen western states, it is recognized, to a greater or lesser degree, in the six states that extend from North Dakota to Texas on the 100th meridian and in the three states that border the Pacific Ocean; in the others, it has been completely repudiated.[16] The appropriation doctrine is a part of the water law of each of the seventeen western states,[17] and some application of this doctrine is likewise made in the statutes of a few eastern states.[18] It follows, therefore, that in some states, the riparian and appropriation doctrines are in effect concurrently.[19]

b. *Percolating ground waters.*[20] The English rule of absolute ownership allows the overlying landowner to abstract ground water from his land at any time and in any quantity, regardless of the effect on the water table in his neighbor's land. Any recession of the water table, even to the point of exhaustion of the supply, caused

[13] See J. R. LONG, A TREATISE ON THE LAW OF IRRIGATION §31 (2d ed. 1916).

[14] See, *e.g.*, Hewitt v. Story, 64 Fed. 510, 514-15 (9th Cir. 1894).

[15] See Ellis, *Some Current and Proposed Water-Rights Legislation in the Eastern States*, 41 IOWA L. REV. 237 (1956); MCGUINNESS, *op. cit. supra* note 5.

[16] See HUTCHINS, *op. cit. supra* note 5, at 42-44.

[17] See *id.* at 74.

[18] E.g., MISS. CODE ANN. §§5956-01 to 5956-30 (Supp. 1956). See also Ellis, *supra* note 15, at 238.

[19] *Cf.* NAT'L RESOURCES PLANNING BOARD, SUBCOMMITTEE ON STATE WATER LAW, STATE WATER LAW IN THE DEVELOPMENT OF THE WEST 99-111 (1943).

[20] See particularly 2 WIEL, *op. cit. supra* note 5, §§1039-66; 2 KINNEY, *op. cit. supra* note 5, §§1185-211; Thompson and Fiedler, *supra* note 5; MCGUINNESS, *op. cit. supra* note 5; Hutchins, *Trends in the Statutory Law of Ground Water in the Western States*, 34 TEX. L. REV. 158 (1955).

by the heavy pumping of any overlying owner is *damnum absque injuria.* In some jurisdictions, this "absolute" rule is qualified by the requirement that the use of the percolating water be not malicious and, in some instances, not wasteful.

The American rule of reasonable use recognizes that the landowner has rights in the water underlying his land, but not unlimited rights. His use of the water must bear some reasonable relationship to the use of the overlying land. Unreasonable uses have been held to include export of ground water from the area that results in impairment of reasonable uses by other overlying landowners and waste of water.

The doctrine of correlative rights has not been clearly distinguished in some jurisdictions from the rule of reasonable use. In California, where correlative rights have been most extensively litigated, their basis is reasonable use, with added elements of coequality of right and apportionment of water in time of shortage.

The English doctrine is followed in some states, both eastern and western. In many jurisdictions, however, it has been replaced by the American rule of reasonable use or by the reasonable use rule as expanded to include aspects of correlative rights. In addition, in a considerable number of western jurisdictions, the appropriative principle has been applied by statute, court decision, or both to rights to use of percolating waters.

2. *Origin of the Doctrines*

a. *The riparian doctrine.* This doctrine came to America from the Roman law by several lines of descent. It was introduced into Texas by the Spanish and Mexican governments, which, in many grants of land, included rights in waters flowing through or adjacent to the grants. Thus, there was brought to the New World the riparian philosophy of the Spanish civil law and of the Roman law from which it was derived; and the policy of granting lands together with rights in adjacent waters was continued by the succeeding governments of the Republic and State of Texas until late in the nineteenth century.[21] On the other hand, the supreme courts of Arizona and New Mexico have declared that in those jurisdictions the riparian doctrine has never existed.[22]

Riparian principles of the French civil law, which were also based on the Roman law, were imported to the Atlantic seaboard by two eminent jurists, Story and Kent, in the early part of the nineteenth century.[23] After Kent and Story had taken the riparian doctrine from the French sources, the courts of England adopted it as a part of their common law, and in so doing, they placed chief reliance on these American authorities.[24] Thereafter, this doctrine became part of the law of numerous American jurisdictions by reason of their adopting the common law as the rule of decision in state and territorial courts.

[21] See Davenport, *Riparian vs. Appropriative Rights: The Texas Experience,* in PROCEEDINGS OF THE WATER LAW CONFERENCES, UNIVERSITY OF TEXAS 138 (1954); Mann, *Riparian Irrigation Rights as Declared and Enforced by the Courts, and Protected by the Statutes, of Texas,* in *id.* at 169.

[22] Clough v. Wing, 2 Ariz. 371, 381, 17 Pac. 453 (1888); Snow v. Abalos, 18 N. Mex. 681, 693, 140 Pac. 1044 (1914).

[23] See Wiel, *Waters: American Law and French Authority,* 33 HARV. L. REV. 133 (1919).

[24] See *id.* at 144-47.

b. *The appropriation doctrine.* This doctrine has various antecedents, both ancient and modern. Views as to the origin of the principle in the Southwest conflict. One is that it had its roots in the civil law of Rome;[25] another, that such "appropriations" arose only as a result of grants of water or of local custom based on prescription.[26] In any event, the principle of exclusive rights in the use of water for lands, regardless of contiguity to streams, materially influenced the development of water law in several states in which the Spaniards and Mexicans had made settlements.

At the middle of the nineteenth century, the Mormons, on public lands in Utah, developed a system of appropriation of their own. By community action, they diverted water from streams and applied it to lands in order to produce the food they needed. When conflicts over the use of inadequate water supplies arose, the Mormons applied the principle of priority in time of beginning use of the water.[27]

During this period also, gold was discovered in the Sierra foothills of California on what were then Mexican public lands but which shortly afterward became part of the public domain of the United States. Miners flocked there from many states and foreign countries. They improvised local rules and regulations for taking and holding mining claims and claims to the use of water for working the mines, with the rule of priority applying to both land and water.[28] These customs were strikingly characteristic of those followed by the Germanic miners in the Middle Ages, which later spread to various European countries and their colonies.[29] Possibly the development of the appropriation doctrine in the California gold fields, instead of being altogether spontaneous, was influenced by what had transpired in other mining regions of the world. Nevertheless, the customs so established became statutory law in various states and territories of the West.

c. *Percolating water doctrines.* The rule of absolute ownership of percolating water is usually traced to an English decision rendered in 1843, although at least one early American decision adopted practically the same general principle.[30] The American rule of reasonable use originated in the eastern states, and out of it grew the correlative doctrine.[31]

3. *Formal Law*

All in all, a considerable body of American law, both statutory and judicial, relates to water rights. The riparian doctrine of surface water rights and the rules of ground water rights based on ownership of land, as recognized in the United States, are composed almost entirely of judicial law. Statutes that purport to affirm the existence

[25] See NAT'L RECLAMATION ASS'N, REPORT AND RECOMMENDATIONS, PRESERVATION OF INTEGRITY OF STATE WATER LAWS 165-68 (1943).

[26] See Mann, *supra* note 21, at 172.

[27] See 1 KINNEY, *op. cit. supra* note 5, §243.

[28] See 1 WIEL, *op. cit. supra* note 5, §§68-71; S. T. HARDING, WATER RIGHTS FOR IRRIGATION 4-5 (1936).

[29] See CHARLES H. SHINN, MINING CAMPS, A STUDY IN AMERICAN FRONTIER GOVERNMENT 11-35 (1948); Colby, *The Freedom of the Miner and Its Influence on Water Law*, in LEGAL ESSAYS IN TRIBUTE TO ORRIN KIP MCMURRAY 67-84 (1953).

[30] See 2 WIEL, *op. cit. supra* note 5, §1039.

[31] See 2 *id.* §1041.

of such rights, when they exist at all, are few and brief. In the West, however, some constitutional and statutory provisions limit the extent and operation of these rights or abrogate them completely.[32]

The appropriation doctrine, although it is both statutory and judicial, was created by neither legislation nor court decision. It was first based on custom, which, in the absence of legislation, the courts recognized as controlling.[33] Generally throughout the West, the earliest statutes essentially codified prevailing local customs, rules, and regulations that had grown up in the appropriation centers.[34] Later, as development progressed and complications ensued, there came the enactment of longer, more detailed, and more comprehensive statutes, supplemented by hundreds of high court decisions as well as constitutional provisions.[35]

C. Property Rights in Water

The water right is real property. The riparian right is said to be not merely an easement or appurtenance, but part and parcel of the land. The appropriative right generally becomes an appurtenance to the land in connection with which the right is completed.[36] These attachments to land, however, are not necessarily permanent.

Except as noted below, ownership of a water right does not constitute ownership of the particles or *corpus* of the water while in the natural source of supply. The owner's right is to take the water from the natural source and to put it to use.[37] The common-law doctrine of percolating water rights, however, provides an exception. Its essential feature is exclusive ownership of the water while it is in one's land.[38] But this so-called "ownership," as has been noted, is one to which the law affords no right of protection against depletion by the heavy pumping of a neighbor.

1. *Waters and Lands*

a. ***Waters to which rights attach.*** Waters to which rights of use attach are chiefly those of natural sources. But a watercourse that was originally constructed artificially, if subjected to long-continued use and acquiescence by interested persons who have come to depend on it, may, by reason of these circumstances, be held to have acquired all the attributes of a natural watercourse and to be subject to all the rights that apply thereto.[39] The general rule also is that both riparian and appropriative rights may attach to navigable as well as nonnavigable waters, but always subject to the public easement for navigation.[40]

b. ***Riparian and overlying lands.*** The water right that pertains to a tract of riparian or overlying land arises by operation of law because the surface stream flows

[32] See NAT'L RECLAMATION ASS'N, *op. cit. supra* note 25, at 31-44.
[33] See, *e.g.*, Jennison v. Kirk, 98 U. S. 453, 457-58 (1879).
[34] See HARDING, *op. cit. supra* note 28, at 22.
[35] See NAT'L RECLAMATION ASS'N, *op. cit. supra* note 25, at 31-44.
[36] See 1 WIEL, *op. cit. supra* note 5, §§550-51, 711; 2 *id.*, §§1103-04.
[37] See 1 *id.*, §18. [38] See 2 *id.*, §1039.
[39] See HUTCHINS, *op. cit. supra* note 5, at 18.
[40] See NAT'L RESOURCES PLANNING BOARD, *op. cit. supra* note 19, at 12.

across it or along its border, or because the waters of a subterranean stream or percolating supply move through the particles of its substrata. Physical contact of land and water is an essential factor. In addition, the weight of authority—at least in the West—is to the effect that a riparian tract cannot exceed the original grant from the government nor extend beyond the boundary of the watershed of the stream to which the tract is contiguous. Moreover, conveyance of any part of the original tract that does not touch the stream (unless otherwise provided in the deed of conveyance) may result in the loss of riparian rights with respect to that part.[41] There are many questionable cases, however, owing to the fact that the courts in some states appear not precisely to have determined what is to be regarded as riparian land.

c. *Lands associated with appropriative rights.* The appropriative right may be acquired and utilized in connection with land, whether or not the land is contiguous to the source of supply. In most western jurisdictions, water may be appropriated for use outside the watershed in which it naturally flows. This is subject to the condition that no injury be inflicted thereby upon existing rights in the original watershed. And in some instances, the watersheds of origin have preferential rights, even though they are not yet exercised.[42] The majority view also is that the appropriator need not be the owner of the land in connection with which he proposes to appropriate water, but must at least be in lawful possession—such as an entryman on public land or a lessee of private land.[43]

2. *Methods of Acquiring Water Rights*

The riparian right of a proprietor of privately-owned riparian land accrues when the land title passes to private ownership—when it is first acquired by grant from the sovereign power or by patent under general land laws. There is no formality in acquiring the water right other than acquisition of title to the land. Rights to the use of percolating waters arising out of ownership of overlying land are acquired in the same way.[44]

Each of the seventeen western states, however, has a statutory procedure under which water of watercourses may be appropriated. Of these states, eleven also have ground-water appropriation statutes. Most of the procedures contemplate applications to state officials to appropriate water, permits, and licenses or certificates when the appropriation is complete. With a few exceptions, the statutory procedures are held or at least considered to be the exclusive means by which an appropriation of water can be made.[45]

3. *Relative Rights of Water Users*

a. *Rights based on landownership.* Where the English doctrine as to percolating water prevails, each landowner holds an exclusive right that is independent of all

[41] See HUTCHINS, *op. cit. supra* note 5, at 40.

[42] See NAT'L RESOURCES PLANNING BOARD, *op. cit. supra* note 10, at 14-15. See also note 78 *infra* and accompanying text.

[43] See *id.* at 12.

[44] See 1 WIEL, *op. cit. supra* note 5, §711; 2 *id.*, §1103.

[45] See Hutchins, *supra* note 20, at 170.

the others. Under the American rule, however, the use of water by each landowner must bear some reasonable relationship to the use of the overlying land. Export of the water from the area for commercial purposes or waste of the water to the injury of others is not a reasonable use; otherwise, the specific criteria governing these relationships have not been well developed.

Rights of riparian proprietors and of overlying owners based on correlative principles are coequal. In time of water shortage, each landowner is entitled to a reasonable share of the common supply. No proprietor acquires an advantage over others solely because he uses the water first; so far as they are concerned, he may begin his reasonable use at pleasure and may suspend his use at any time and resume it at will.[46]

b. *Appropriative rights.* Each appropriator is entitled to the use of whatever water he needs, up to the limit of the terms of his right, out of whatever surplus water there may be in the supply above the aggregate quantities necessary to satisfy all rights prior to his own, before any water may be claimed by appropriators subsequent to him in time. This is true regardless of the relative locations of headgates on the stream.[47]

4. *Quantity of Water*

a. *Rights based on landownership.* These rights normally do not relate to specific quantities of water. The riparian or correlative overlying owner is entitled to a reasonable share of the aggregate quantity of water available for the requirements of all owners at a particular time. In the event of shortage, apportionment of the supply may be made by court order. Decrees of apportionment take account of the then existing needs of the landowners, usually on a proportional basis, and remain in effect as long as the conditions remain substantially the same as at the time of apportionment. But a new or a modified apportionment may be made whenever the conditions justify it. The law has not been clearly developed in such respects in some riparian states that follow a doctrine of reasonable use, while in some states, certain elements of the 'natural flow' rule may still apply.[48]

In California, riparian or correlative proprietors are held to be entitled to all the water of a particular supply that they can put to reasonable beneficial use on their lands, but to no more; and appropriators may take the surplus. In case of controversy, the riparian or overlying owners must first prove the quantities of water they need, whereupon the burden is shifted to the appropriators to prove the existence of a surplus in the supply to which their rights may attach. Quantitative limitations on the riparian and overlying rights then become specific.[49]

b. *Appropriative rights.* Appropriative rights do relate to specific quantities of water. The element of priority negatives any obligation on the part of the appropri-

[46] See *id.* at 160-65. See also WELLS A. HUTCHINS, THE CALIFORNIA LAW OF WATER RIGHTS 436-41, 446-54 (1956).

[47] See 2 KINNEY, *op. cit. supra* note 5, §§782-85.

[48] See 1 WIEL, *op. cit. supra* note 5, §§751-53.

[49] See HUTCHINS, *op. cit. supra* note 46, at 226, 441-44.

ator to share with other appropriators, in proportion to their respective reasonable needs, a water supply that is not enough to fill their aggregate quantitative requirements. But at no time is the appropriator entitled to divert and use more water than he then needs, even though the quantity he needs may be much less than that to which his right relates. Whatever part of the water covered by an appropriative right is not needed is available for other appropriators in the order of their respective priorities.[50]

5. *Purpose of Use of Water*

a. *Beneficial uses.* Generally, any use of water that is beneficial may be made in the exercise of a water right.

b. *Preferences in use of water.* Riparian uses of water are divided into natural or ordinary uses, and artificial or extraordinary uses. Natural uses are those necessary to maintain the lives of occupants of the riparian land; artificial uses are commercial or business uses, such as irrigation, industrial, and development of power. Preference is accorded to natural uses in time of water shortage, and to upstream natural uses over those downsteam.[51]

Notwithstanding the basic feature of priority, the constitutions and statutes of a few western states provide, in effect, that when the water supply is not enough for all appropriators, domestic users shall have the first preference and irrigators the second. In some cases, compensation is required. Regardless of the wording of the provision, however, no supreme court decision has come to attention in which such a preference has been enforced as against the holder of a right prior in time without payment of compensation.

Preferences in acquiring appropriative rights are expressed in some statutes. Some preferences apply in the granting of permits, such as between conflicting applications that are pending before the state administrator at the same time; or in imposing conditions in a permit, subordinating it to subsequent permits for preferred uses. The purpose of others is to provide for the condemnation of inferior rights for superior purposes. And in still other cases, municipalities are granted certain preferences in appropriating water.[52]

6. *Exercise of Water Rights*

a. *Handling of water.* Water may be diverted at any convenient point on riparian land. Under some circumstances, it may even be diverted upstream, so long as the rights of other proprietors are not impaired. The unused portion of diverted water must be returned to the stream above the lower boundary of the riparian land, or at least above the diversions of downstream owners.[53] In the case of an appropriator, however, the point of diversion is an element of his water right; it is there that the right attaches to the stream.[54] And any unused water so diverted must be promptly returned to the stream.[55]

[50] See 2 KINNEY, *op. cit. supra* note 5, §§782-85.
[51] See 1 WIEL, *op. cit. supra* note 5, §§740-44.
[52] See HUTCHINS, *op. cit. supra* note 5, at 337-58.
[53] See 1 WIEL, *op. cit. supra* note 5, §§754-55.
[54] See NAT'L RESOURCES PLANNING BOARD, *op. cit. supra* note 19, at 10.
[55] *E.g.*, Natoma Water & Min. Co. v. Hancock, 101 Cal. 42, 51-52, 31 Pac. 112 (1892); Fort Lyon

Methods of diverting, conveying, and using water must be reasonably efficient. In current water-law philosophies, unnecessary waste of water is within neither the riparian nor the appropriative right; but in applying the requirement of reasonable efficiency to the circumstances of a given case, the custom of the country is an important influence.[56]

The riparian or overlying water right may be exercised at any time of the year. The appropriative right, on the contrary, relates to a specific period. This may be the entire year, as in some parts of the American Southwest, or it may be for certain months only.[57]

b. *Changes in exercise.* Water rights of lands based on contiguity to the source of water supply do not, of themselves, contain limitations on the right of the proprietor to change his points of diversion and return of the water from place to place within his riparian tract, or to change the place of use from one part of the tract to another, or to change the purpose of use of the water. Presumably such changes may be made so long as the new use or method of use is within the scope of the water right.[58]

In most western states, too, an appropriator may change the location of his point of diversion, place of use, or purpose of use, provided the rights of others are not thereby impaired. Some statutes contain procedure by which the change may be formally made and recorded. In some states however, such changes may be made only with permisison of the state engineer, after petition and hearing of objections.[59]

7. *Loss of Water Rights*

a. *Abandonment.* Appropriative rights may be lost by abandonment, when the intent of the holder to give up his right is accompanied by actual relinquishment. No time element is involved. When intent and relinquishment concur, abandonment takes place instantly.[60] Riparian and other rights that inhere in ownership of land and that are part and parcel of the land, on the other hand, are not subject to abandonment. Such rights are not created by use, and in the absence of prescription, they are not lost by disuse.[61]

b. *Statutory forfeiture.* Statutes of many western states provide that failure to make use of an appropriative right for a specified period of years results in forfeiture of the right. Intent is not material; the essential elements are nonuse and lapse of

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Canal Co. v. Chew, 33 Colo. 392, 399-400, 81 Pac. 37 (1905); Gunnison Irr. Co. v. Gunnison Highland Canal Co., 52 Utah 347, 357, 174 Pac. 852 (1918); Anderson v. Bassman, 140 Fed. 14, 29 (N.D. Cal. 1905) (decree restricting upstream claimants, whether riparian or nonriparian owners, from using water from the stream where no provision was made for returning the surplus water thereto).

[56] See HUTCHINS, *op. cit. supra* note 5, at 306-09, 316-20.

[57] See NAT'L PLANNING RESOURCES BOARD, *op. cit. supra* note 19, at 10.

[58] See 1 KINNEY, *op. cit. supra* note 5, §521.

[59] See NAT'L PLANNING RESOURCES BOARD, *op. cit. supra* note 19, at 15-16.

[60] See 1 WIEL, *op. cit. supra* note 5, §§567-69; 2 KINNEY, *op. cit. supra* note 5, §§1100-05.

[61] See 1 WIEL, *op. cit. supra* note 5, §861; NAT'L RESOURCES PLANNING BOARD, *op. cit. supra* note 19, at 17.

time.[62] The forfeiture statutes do not, however, apply to riparian and correlative percolating water rights.[63]

c. *Prescription.* Water rights of most types are subject to loss by adverse possession and use, for the period of time prescribed by the statute of limitation of actions to recover real property, when accompanied by all the elements necessary to establish prescription.[64] Losses by prescription have been adjudicated with respect to riparian rights, correlative rights of overlying landowners, and appropriative rights.[65]

d. *Estoppel.* Equitable estoppel may occasion the loss of an appropriative right.[66] Under some circumstances, a riparian owner, too, can be estopped from objecting to an appropriative diversion that deprives him of the use of water to which he would otherwise be entitled.[67]

e. *Other ways of severing riparian rights from land.* In California, where cases of severance of riparian rights from riparian land have been most extensively litigated, the following principles have been declared:[68]

(1) A riparian owner whose land is cut off by avulsion from contiguity to the stream thereby loses his riparian right, unless he restores the stream to its original channel within a reasonable time and without trespassing on the lands of others.

(2) In the subdivision of a riparian tract, parcels, lying back from the stream which are thereby cut off from contact lose their riparian rights, unless the intention to preserve them is mentioned specifically in the deeds or is necessarily implied by the circumstances. If the riparian right of a detached parcel is once lost, it can never be regained, even if the parcel is later united in ownership with lands contiguous to the stream.

(3) In a partition of riparian land, riparian rights are preserved in all of the subdivided parcels, whether or not severed from contact with the stream, unless the decree of partition provides otherwise.

(4) A riparian owner who sells his land may reserve the riparian right by a clause in the deed of conveyance.

(5) A riparian owner may grant his riparian right to another person who proposes to divert the water to nonriparian land. Such a grant is not made in the exercise of his riparian right, and it does not transfer the riparian right to nonriparian land. Its only effect is to waive the right of the grantor to object to the grantee's diversion.

[62] See 1 WIEL, *op. cit. supra* note 5, §§574-78; 2 KINNEY, *op. cit. supra* note 5, §§1118-20; HUTCHINS, *op. cit. supra* note 5, at 392-97; NAT'L RESOURCES PLANNING BOARD, *op. cit. supra* note 19, at 17-18.

[63] *E.g.*, Tulare Irr. Dist. v. Lindsay-Strathmore Irr. Dist., 3 Cal.2d 489, 530-31, 45 P.2d 972 (1935); Freeland v. Peltier, 44 S.W.2d 404, 408 (Tex. Civ. App. 1931); Pasadena v. Alhambra, 33 Cal.2d 908, 933-34, 207 P.2d 17 (1949).

[64] See NAT'L RESOURCES PLANNING BOARD, *op. cit. supra* note 19, at 18-19. See also Craig, *Prescriptive Water Rights in California and the Necessity for a Valid Statutory Appropriation*, 42 CALIF. L. REV. 219 (1954).

[65] See 1 WIEL, *op. cit. supra* note 5, §§579, 863, 1170. See also Pasadena v. Alhambra, 33 Cal.2d 908, 926-33, 207 P.2d 17 (1949).

[66] See 1 WIEL, *op. cit. supra* note 5, §§593-95.

[67] See HUTCHINS, *op. cit. supra* note 46, at 193-94.

[68] See *id.* at 189-96.

The contract is binding on the parties and their successors but not on other riparian owners who do not consent to the transaction.

(6) The riparian right may be condemned for public use under the laws relating to eminent domain.

8. *Permit Systems*

In some eastern states, legislation requires a permit from a state agency to take water for irrigation or other purposes from a watercourse; and in a few states, from a ground-water source. It is doubtful whether, in most such states, these permits create any substantial property rights.[69] Although they probably have little effect on riparian rights, they may provide some administrative restraint upon the exercise of these rights, and they do provide a record of use that should be extremely useful in considering water rights legislation and administration in the future.

D. Conflicts and Their Adjustment

1. *Riparian and Appropriative Rights*[70]

The conflict between appropriative and riparian rights has been significant only in the seventeen western states. There, the century-old impasse has been settled in some jurisdictions, at least so far as basic principles go, but it still persists in others.

Individual conflicts have stemmed principally from the asserted right of the riparian owner to have the stream flow down to his land. Although the "natural flow" theory of the common law had been so modified, where irrigation was important, as to allow each riparian owner to make a reasonable use of the water on his riparian land, even though the result was to lessen the flow to downstream proprietors, there was nothing in the riparian doctrine that required the latter to submit to upstream diversions to nonriparian lands. On the same stream, then, there have been riparian landowners who have claimed that their water rights entitled them to the full flow of the stream as against nonriparian diversions, whether or not the riparians had ever used the water or presently intended to do so; and appropriators who have claimed that priority of diversion and use of water should govern, whether the use be made on riparian or nonriparian land. Conflicts also have resulted in some areas from claims by riparians of the right to use water wastefully or to withhold use without losing the right. And in still others, they have arisen simply from competition between early and late comers for the use of water supplies not sufficient for all.

Considering the West as a whole, the trend has been toward bringing the operation of the riparian doctrine—where it is recognized—more into line with standards of use generally applicable to appropriators. This has been accomplished by substantially modifying the common-law right for the purpose of reducing or eliminating its obstructive aspects. At present, a riparian owner has no more license to waste water than has an appropriator; and the appropriator never has had the right to do that, although in practice, he may, in many cases, actually have diverted more than

[69] See Ellis, *supra* note 15, at 238.

[70] See generally, Hutchins, *History of the Conflict Between Riparian and Appropriative Rights in the Western States*, in PROCEEDINGS OF THE WATER LAW CONFERENCES, UNIVERSITY OF TEXAS 106 (1954).

he put to beneficial use. In a few of the western jurisdictions, however, the interrelationships of riparian and appropriative claimants have not yet been definitely established.

a. *Nature of adjustments.* The riparian-appropriative conflict has effectively been settled in eight of the seventeen western states by repudiating the riparian doctrine *in toto.* In some of these jurisdictions, the doctrine never had been recognized. In a few, its status was in question during the early years of water development. And in one state, the supreme court actually recognized the riparian doctrine for a time and then repudiated it.

In the dual-system states of the West—the six lying on the 100th meridian and the three bordering the Pacific Ocean, some portions of which are generally humid and other portions generally arid or semiarid—conflicts have resulted in retaining the riparian doctrine but modifying its principles. The extent of modification of the common-law doctrine and the resulting effectiveness of the appropriative principle when opposed, in a particular area, by the riparian vary considerably. Some examples are:

(1) As the result of legislation and court decisions, the riparian doctrine has been reduced to little more than a legal fiction and to minor importance in the economy of the state.

(2) The riparian owner must put the water to reasonable use in order to hold it as against the claim of an appropriator.

(3) The riparian doctrine in its reasonable-use phase is fundamental, but superimposed upon it is a system of appropriative rights that relate to the surplus waters above those to which riparian rights attach. With respect to the full quantities of water necessary to supply the riparians, their rights are paramount. But equally paramount to the claims of riparian owners are appropriative rights with respect to the surplus.

b. *Unused riparian rights.* A major difficulty in these adjustments is the matter of unused riparian rights. In as much as in the strict application of the riparian doctrine the water right is neither gained by use nor lost by disuse, future use stands as high as present use and is equally entitled to protection of the law against impairment by appropriative diversions. This right reaches into the indefinite future; there is no time limitation whatsoever.

In jurisdictions in which the courts hold to the sanctity of the unused right, statutory attempts to provide for their forfeiture have not been tolerated. California is one of these states. There, in order to preserve the unused right from loss by adverse use, the riparian owner may obtain a declaratory decree against a person whose diversion for nonriparian purposes threatens to ripen, if continued, into a prescriptive right. The effect of this declaratory judgment and decree is to enjoin the adverse party from diverting the water at any time the riparian wishes to use it and from claiming a right by adverse use as against the latter.

The question of unused riparian rights has been met in some other states

by requiring the riparian owner to begin making beneficial use of the water within a certain time fixed by statute, or, in the event the water is wanted by an appropriator, either to begin use within a reasonable time or to allow the appropriative right to take precedence. Whether the courts have gone along with legislative attempts to do this has depended upon the extent to which they considered their former declarations as to future use stare decisis.

2. *Ground Water Rights*

2. *Correlative overlying and appropriative rights.* Conflicts between these rights have been confined to much smaller areas and to shorter times than have the historic riparian-appropriative conflicts. In California, where they have had the attention of the courts in a considerable number of cases, the interrelationships are the same as those of riparian and appropriative rights. Basically, the rights of overlying owners are paramount, and appropriators for nonoverlying uses may take the surplus. And an overlying owner may have his right of future use protected by obtaining a declaratory judgment and decree.[71]

b. *Absolute ownership and appropriative rights.* The conflict between a right of absolute ownership of percolating water and a right of appropriation in a stream with which the percolating water is physically connected is irreconcilable. There is no present legal basis for adjusting such conflicting rights so long as the right of an overlying landowner to the ground water in his land is held to be absolute.

E. Comparative Evaluation

To the extent that water development is carried on by individuals and small groups, the question of what basic doctrine shall prevail comes to the fore. The following comparisons are based on western experience with the appropriation and riparian doctrines. This experience cannot, it should be noted, be carried directly to eastern problems without extensive study and probably some trial and error.

1. *Riparian Doctrine*

a. *Some advantages.* By contrast with the appropriator who holds a junior or late-season right, the riparian landowner is assured of at least some water whenever it is available.

In its common-law form, the riparian right is not lost solely by disuse; although in some western jurisdictions the right must be exercised if the landowner is to hold it. Where this right of future use is recognized, the riparian right may be safeguarded by declaratory decree against loss by prescription on the part of an appropriator. This is an obvious advantage from the standpoint of the riparian owner. From the standpoint of "unfreezing" unused water rights so that the water may be made available for use, however, it is a material disadvantage.

In the West, the trend is to hold the riparian owner to reasonable use as against an appropriator as well as against other riparian proprietors.

Although the right of a riparian owner encompasses the use of the water only

[71] See HUTCHINS, *op. cit. supra* note 46, at 441-46, 454-59, 493-94, 498, 500.

on his riparian land, he can purportedly sell his riparian right to a nonriparian owner, the effect of which (in California) is simply to estop him from objecting to the latter's diversion.

The riparian doctrine is better suited to a situation in which the demand for the water does not exceed the supply and large investments are not required to develop water supplies.

b. *Some disadvantages.* Where the right of future use is recognized, the unused riparian right can be held indefinitely without forfeiture, which means that riparian owners who have been making use of the water may have to forego some of their accustomed use when the previous nonusers elect to demand their shares.

The riparian doctrine tends to "freeze" a variable quantity of water to a specific tract of land. By contract, however, at least in California, the riparian owner can ostensibly sell his riparian right to a nonriparian and thus estop himself from objecting to the latter's diversion.

In its common-law form, the riparian right contemplated forebay storage only. In California and Washington, the courts have held that the riparian right does not cover seasonal storage of water; such storage may be accomplished only under appropriative rights.

Originally in California, where most of the disputes between riparian owners and appropriators have been litigated, the courts held that the riparian owner was not limited to any measure of reasonableness as against an appropriator. Now, as a result of a constitutional amendment and its favorable interpretation by the supreme court of the state, the riparian is limited to reasonableness as against appropriators as well as against other riparians.

The contribution of the riparian doctrine to the building of western agriculture has been much less than that of the appropriation doctrine. The riparian doctrine apparently was satisfactory in eastern states until recent demands for water raised questions of adequate supplies.

2. *Appropriation Doctrine*

a. *Some advantages.* This doctrine assures the holder of the water right of his full appropriative supply of water, in order of priority, whenever the water is available. Hence, early priorities have reasonable assurance of a water supply each year. Thus, it enables development to be predicated on a reasonably assured water supply. Much of this advantage would be lost if water could be appropriated for only a period of years, not in perpetuity, in an area in which irrigation is necessary to agriculture.

Although in early days there were rendered some excessive decrees that still give trouble, the appropriation doctrine always has been limited, in theory, to beneficial use. It has come to be further limited to economical or reasonable use as against other appropriators. This does not mean a sharing of the water by senior and junior appropriators in time of shortage; it means simply that the appropriators shall divert, convey, and use the water not only without unnecessary waste, but with as high a

degree of efficiency as is consistent with the general economy and actual practices of the community.

Appropriation statutes can, and many of them do, provide restrictions on the right to appropriate water in the interest of the public welfare. Such restrictions have not yet included criteria based on character of the land; but there is no reason why the state could not provide that an application to appropriate water shall be rejected where the land proposed to be irrigated is poor, thus withholding the water in favor of later applicants for use on better land. The state grants the right to appropriate water, and it can certainly regulate the method of appropriation. This would be a proper exercise of its police power.

Water can be appropriated for storage for beneficial use, whether the storage be temporary or seasonal.

The prevalence of provisions in the western statutes, and approval of the principle by the courts, for changes in exercise of water rights—point of diversion, place of use, and purpose of use—where no injury is inflicted on others, allows a considerable measure of flexibility in the application of this doctrine.

The appropriative right can be lost by abandonment or statutory forfeiture. An essential feature of the appropriative right is that it is gained by use and may be lost by disuse.

On the whole, the appropriation doctrine has contributed materially to the agricultural development of the West, where the acreage of good land has exceeded the quantity of water with which to irrigate it.

b. *Some disadvantages.* Holders of late priorities probably have little assurance of water supply in most seasons, and the very late ones have no assurance except in years of extremely heavy runoff. Under the essential philosophy of the doctrine of prior appropriation, diversions under later priorities are reduced or cut off entirely when the supply is less than sufficient to fill the requirements of all those earlier in point of time.

The appropriation doctrine tends to "freeze" a specific quantity of water to a specific tract of land. The provisions for transferring the use of the water to other purposes or to other lands tend to lessen this disadvantage; but there is no provision in the law, aside from condemnation, for requiring an appropriator to accede to a change of the place of use of his appropriated water from one tract to another so long as his right is in good standing. In other words, there is a large measure of inflexibility with respect to a continuously-used appropriative right, even though the water might be put to better use elsewhere.

In areas in which both riparian and appropriative rights are recognized, a riparian owner may prevent the ripening of a prescriptive right in favor of an appropriator by obtaining a declaratory decree against him.

3. *Summary.*

This enumeration of the asserted advantages and disadvantages of the riparian

and appropriation doctrines, as they influence individual effort in developing water resources, seems to indicate the need for modification in both doctrines in the future to meet changing economic conditions. In the eastern states, there is a strong movement toward modification of the riparian doctrine to foster more development of water resources by individuals and small groups. The purpose is to assure the person who develops a water supply a reasonable opportunity to recover the benefits from his efforts. This movement to modify the riparian system might be characterized as a move toward certain elements of the appropriation doctrine, but it will probably result in something quite different from the western appropriation doctrine.

Because of the nature of the remaining opportunities in surface water resources, our greatest future development will come from group enterprises and large-scale public projects encompassing entire river basins. The relation of the above-outlined water rights doctrines to such projects will, accordingly, be explored in the next part.

III

IMPLICATIONS FOR RIVER BASIN DEVELOPMENT

A. By Whom Is the Development to Be Made?

The implications of the various water rights doctrines for river basin development will depend, to some extent, on which agency or agencies participate in the undertaking. Will the development be made exclusively by federal, state, district, or individual effort, or by some combination or combinations of these?

Let us assume, first, that the federal government will develop the river basin.

The powers of the federal government are limited to those delegated by the Constitution. Over the years, these delegated powers have been interpreted by the Supreme Court and extended by congressional action to provide a significant body of law and authority for water resources development as to navigation, flood control, irrigation, power, other public purposes, and related land uses. Under the commerce power,[72] for example, Congress has jurisdiction over all navigable waters and nonnavigable tributaries as related to navigable capacity of the navigable waterways. And not only has the Supreme Court outlined the authority available to carry out this specific function, but it has also indicated that in the exercise of the commerce authority, there is no constitutional impediment to Congress in comprehensive development of navigable rivers and their watersheds:[73]

> It is for Congress alone to decide whether a particular project, by itself or as part of a more comprehensive scheme, will have such a beneficial effect on the arteries of interstate commerce as to warrant it. That determination is legislative in character.

In section eight of the Reclamation Act of 1902,[74] based on the property clause,[75] which vests in Congress the authority to control the use of federal public lands, how-

[72] U.S. CONST. art. I, §8, cl. 3.
[73] 3 PRESIDENT'S WATER RESOURCES POLICY COMM'N, REPORT 23 (1950).
[74] 32 STAT. 390 (1902), 43 U.S.C. §383 (1952).
[75] U.S. CONST. art. IV, §3, cl. 2.

ever, the Secretary of the Interior is directed to proceed, in carrying out the terms of that act, in conformity with state laws relating to the control, appropriation, use, or distribution of water used in irrigation. There is now a vigorous movement to have Congress apply that same principle to all federal agencies in dealing with water where rights of use may be affected.

Let us assume, second, that the state will develop the river basin, as California proposes to do with respect to the Feather River.

In such instances, the state files on the unappropriated water in the basin, stores the water and conveys it to the places of use, and delivers it to consumers through the media of organizations. The state is the formal appropriator, as is the Bureau of Reclamation with respect to federal reclamation projects, and the state contracts with intermediate organizations for delivery to the water users; but some courts say that these users are the actual appropriators, even though title to the right is held by the agency that makes the formal appropriation.[76]

Planning and development in river basins, however, will probably be carried out by combined efforts. The Advisory Committee on Water Resources Policy suggests that to achieve the maximum beneficial use of water resources, planning for their use must be participated in by the interested federal agencies, the states, local governments, and private citizens.[77] Full development will require the resources and powers of both state and federal governments.

Under our system of constitutional government, it is fundamental that rights of private property must be respected. Persons may not be deprived of their property without due process of law, nor may private property be taken for public use without just compensation. But by exercising the power of eminent domain, a governmental or public agency, when adequately empowered and financed, may take established rights of property—in this case, water rights—and may reshuffle the water and its uses and users through the medium of contractual relationships.

B. What Are the Existing Water Rights Doctrines in the River Basin?

In all states in which planned river basin development will take place, some form or forms of water rights doctrine already exist. In the West, this may be solely the appropriation doctrine for surface streams, or it may be appropriation and riparian combined; for percolating ground water, it may be appropriation, or it may be some principle that rests on ownership of overlying land. In the east, this will generally be the riparian doctrine as to surface water, and either the doctrine of absolute ownership or that of reasonable use with respect to percolating ground water.

[76] Ickes v. Fox, 300 U.S. 82, 93-95 (1937); Nebraska v. Wyoming, 325 U.S. 589, 612-15 (1945); Murphy v. Kerr, 296 Fed. 536, 544-45 (D. N. M. 1923), *aff'd*, 5 F.2d 908 (8th Cir. 1925); Prosole v. Steamboat Canal Co., 37 Nev. 154, 159, 162-65, 140 Pac. 720, 144 Pac. 744 (1914); Whiting v. Lyman Water Co., 59 Ariz. 121, 124, 124 P.2d 316 (1942). *Contra*, Farmers' Cooperative Ditch Co. v. Riverside Irr. Dist., 14 Idaho 450, 457-59, 94 Pac. 761 (1908); *In re* Walla Walla River, 141 Ore. 492, 496-98, 16 P.2d 939 (1932). Neither the ditch company alone nor the users alone are appropriators in the strict sense of that term. Jefferson County v. Rocky Mountain Water Co., 102 Colo. 351, 356, 79 P.2d 373 (1938). See discussion in 2 WIEL, *op. cit. supra* note 5, §§1338-47.

[77] PRESIDENTIAL ADVISORY COMM. ON WATER RESOURCES POLICY, *op. cit. supra* note 1, at 14.

In jurisdictions in which the riparian doctrine is firmly established, there may be a question of superimposing some form of the appropriative principle on the underlying riparian system, because the riparian doctrine, in its original common-law form, is not alone adequate for river basin development in any area in which the available water supply falls short of the quantity needed for all demanded uses. In these jurisdictions, the riparian right probably is not lost by mere failure to exercise it, so that an unused right may be put to use at any time in the future, regardless of demands of appropriators. This presents a serious problem; but if, in a given state, the court decisions with respect to the vesting of riparian rights are few and of little practical effect, the changeover to a predominantly appropriative system might be less difficult.

In states in which the riparian doctrine has been repudiated and rights to the use of water may be obtained only by appropriation, riparian problems are a thing of the past—if they ever existed—and a major problem is and will be to use the appropriative principle to its best advantage and to make needed modifications to conform to large area development.

Where the riparian and appropriation doctrines exist concurrently, their adjustment necessarily poses substantial problems. This is the case in the two largest states, where adjustments between these basic doctrines have been made, are being made, and doubtless will continue to be made.

C. Water Rights Doctrines in Relation to Continuing Large-Scale Development

The trend in both the West and the East is toward large-scale development of surface water supplies. In many areas, the smaller opportunities are largely exhausted, and group organizations and public agencies have been and are being more and more employed for the purpose of storing water and conveying it considerable distances to the places of use. An extreme example: The Feather River Project in California proposes to take water from the northern Sierra Nevada and convey it almost to the Mexican border—a distance of hundreds of miles, down the Sacramento Valley, up the San Joaquin Valley, over a mountain range, and thence into southern California. The principal water rights problem there is created by the "areas of origin" statute which requires that areas in which water originates shall not be deprived of the full quantity they need by reason of any state or federal project.[78] The State Department of Water Resources is directed to file on all unappropriated water needed for state projects. When the "areas of origin" question is settled—by some arrangement that will safeguard not only the valid claims of areas of origin, but also the equities of areas to which the excess water is exported—a major problem in such projects will be that of dealing with users of water on the basis of contractual relationships, rather than individual water rights.

In Nebraska, too, an issue arose as to whether the state should permit the

[78] See CAL. WATER CODE ANN. §§10500, 10504, 10505 (West 1956) (water supplies of counties of origin); *id.* §§11128, 11400, 11451, 11452, 11460, 11461, 11462, 11463, 11500 (water supplies of watersheds or areas of origin).

diversion and use of stored water to irrigate lands outside the basin from which the water was originally taken when the Central Nebraska Public Power and Irrigation District proposed to take some 600,000 acre-feet of water annually from the Platte River and use about sixty per cent of it outside the Platte River basin in the Republican River basin. The Department of Roads and Irrigation granted the necessary water allotments, but this action was appealed by both appropriators and riparians in the Platte Valley. After reviewing the legislative history and the impact on the economy of the Platte Valley, the Nebraska Supreme Court overruled the Department of Roads and Irrigation and declared the applications of the District to be revoked.[79] Several bills have since been introduced in the state legislature to authorize transwatershed diversion, but none has passed, and the laws of Nebraska, as interpreted by the state supreme court, now forbid transwatershed diversion.[80] This provision has direct impact on river basin development. Not only did the Central Nebraska Public Power and Irrigation District have to confine its water use development activities to the Platte River basin, but other proposed transwatershed diversions, as proposed by the Bureau of Reclamation, could not be undertaken. River basin development plans have, accordingly, been redirected toward the utilization of water resources within the watershed of origin.

Several other problem situations also arise in connection with large-scale development under the riparian system. The most commonly discussed is that faced by a group enterprise in developing a water supply for irrigation when it is economically desirable to store water and use it on lands not contiguous to the stream. Similarly, under the riparian doctrine, particularly as to nonnavigable watercourses, a city often does not have authority, solely as riparian owner, to transport water great distances for its use. It may, however, acquire needed rights through such measures as purchase, condemnation, and prescription. And in another situation, large-scale development by state, or more often by federal, agencies results in the almost complete elimination of private riparian rights. This is true where reservoirs are built to develop fully the power potential of a stream. Lands are purchased or condemned for reservoir purposes, and access to the reservoir is by permission of the developing agency. Between the lowest dam and the backwater of the highest reservoir, the river may be completely controlled, and, unless specifically reserved, riparian rights are acquired by the agency. In case of navigable streams, it has been held that the federal government holds a navigation easement and does not need to pay for riparian water rights where the development is for navigational purposes.[81] Any use of water from the

[79] Osterman v. Central Nebraska Public Power & Irr. Dist., 131 Neb. 356, 268 N.W. 334 (1936). NEB. REV. STAT. §46-206 (1943) provides that water diverted from a stream shall not be turned into any other stream unless the former exceeds 100 feet in width, in which case not more than 75 per cent of the regular flow shall be taken. Sec. 46-265 provides that unused water shall be returned to the stream from which taken, or to the Missouri River. These sections, said the supreme court in the *Osterman* case, as a practical matter, necessarily limit the location of canals to places within the watershed of the stream that is the source of water supply.

[80] NEBRASKA LEGISLATIVE COUNCIL, SUBCOMMITTEE ON WATER DIVISION, FINAL REPORT 25 (1944).

[81] See 3 PRESIDENT'S WATER RESOURCES POLICY COMM'N, *op. cit. supra* note 73, at 25-29.

reservoir must be under contract with the developing agency. With such complete development, the end result of large-scale development under the riparian system is apparently no different from the end result under the appropriation doctrine.

It seems inevitable that as these large-scale and basin-wide developments progress—necessarily with the aid of public financing and with control by public agencies or large group organizations—the water rights of new users will be represented less and less by permits and certificates of appropriation issued by the state engineers, and more and more by water service contracts with organizations charged with the distribution of water to users—which organizations themselves may either have appropriated the water, acquired all the riparian rights, or contracted for water supplies from public agencies which are the formal appropriators.

D. Coordination of Surface and Ground Water Rights

An important feature of successful river basin development is the coordination of all rights to the use of interconnected water supplies, both surface and subterranean. If all rights of use are governed by the appropriation doctrine, correlation is made on the basis of priority of appropriation. An example is Colorado, where rights that pertain to a certain stream are subject to prior rights in ground waters that feed the stream, and vice versa.[82]

If part of the rights are riparian and part appropriative, however, as in California, coordination includes adjustment of the two conflicting principles and correlation of all rights on the basis of reasonable beneficial use. Coordination is legally possible in cases in which there is some give-and-take, such as between rights of prior appropriation and riparian rights that have been restricted to reasonable beneficial use against appropriators. It is not legally possible in a case in which owners of lands overlying percolating waters tributary to a surface stream are recognized by the courts as having absolute ownership of the percolating water. In such a case, these landowners may lawfully cut off the percolating water entirely for their own use before it gets out of their lands and enters the stream. Nor is coordination possible where percolating water in these lands, instead of being tributary to a stream, has escaped from it. In that case, those who hold rights in the stream may, in the exercise of such rights, cut off the escaping supply completely without recourse on the part of the overlying owners, no matter how long the latter may have been using the ground water. By hydrologic processes, the percolating water enters and leaves the substrata of the overlying owner. While the water is in his land, where this doctrine prevails, he has an absolute right to use it; before entering his land, or after leaving it, no right at all.

E. Interstate Matters

River basins do not respect state lines. A number of cases have arisen and have been decided with respect to rights to the use of water of interstate streams. In some

[82] Black v. Taylor, 128 Colo. 449, 458-59, 264 P. 2d 502 (1953); Nevius v. Smith, 86 Colo. 178, 181-83, 279 Pac. 44 (1929); Faden v. Hubbell, 93 Colo. 358, 368-69, 28 P. 2d 247 (1933); Safranek v. Limon, 123 Colo. 330, 334-35, 228 P. 2d 975 (1951).

such cases, private parties only have been involved; most of these have been litigated in federal courts. Others have risen to the dignity of interstate suits, brought and decided in the United States Supreme Court, which has original jurisdiction of litigated controversies between states.

The United States Supreme Court has laid down broad principles that must govern its decisions in such cases.[83] Each state across which, or along the borders of which, an interstate stream flows is entitled to an equitable apportionment of the benefits of the stream. There is no set formula for making such an apportionment. Of those cases that have been litigated in the West, no two are alike. The Supreme Court takes the view that a contest between states is to be settled "in the large and ample way that alone becomes the dignity of the litigants concerned."[84] The wide range of physical and legal conditions and combinations of conditions in interstate river basins is reflected in the diverse ways in which the Supreme Court has handled this broad principle of equitable apportionment of benefits between states.[85]

In addition to litigation in the Supreme Court, apportionments of waters of various interstate streams have been made by compact, with the consent of Congress.[86] The Supreme Court has recommended that this, rather than resort to the Court, be the medium of settlement,[87] and it has held that whether an apportionment be made by compact or by decree of the Court, it is binding on the citizens of each state and on all water claimants.[88]

There are some state statutes with respect to the appropriation of water within one state for use in another. A few states make it difficult or impossible to divert water legally within their boundaries for conveyance across the state line for use in an adjoining state. Others have what are called reciprocal statutes—they permit such appropriations to be made, provided the sister state enacts similar legislation.[89]

F. Resource Management Districts

As the demand for water increases and we apply more conservation measures on our land, more management and water-control measures on our watersheds, and more dams and channel-control structures on our rivers, we will reach a point at which all sizable streams and rivers will be more or less regulated and managed, and the concept of "natural flow" will have little meaning. Water supplies will be man-

[83] See 3 PRESIDENT'S WATER RESOURCES POLICY COMM'N, *op. cit. supra* note 73, at 58.

[84] Washington v. Oregon, 297 U.S. 517, 529 (1936).

[85] *Cf.* Kansas v. Colorado, 206 U.S. 46, 95-114, 117 (1907); Wyoming v. Colorado, 259 U.S. 419, 464-71, 488-89, 496 (1922); Connecticut v. Massachusetts, 282 U.S. 660, 669-74 (1931); New Jersey v. New York, 283 U.S. 336, 342-48 (1931); Washington v. Oregon, 297 U.S. 517, 522-30 (1936); Hinderlider v. La Plata River & Cherry Creek Ditch Co., 304 U.S. 92, 101-11 (1938); Colorado v. Kansas, 320 U.S. 383, 391-400 (1943); Nebraska v. Wyoming, 325 U.S. 589, 617-27, 631-46 (1945).

[86] See 3 PRESIDENT'S WATER RESOURCES POLICY COMM'N, *op. cit. supra* note 73, at 64.

[87] See Colorado v. Kansas, 320 U.S. 383, 392 (1943).

[88] Hinderlider v. La Plata River & Cherry Creek Ditch Co., 304 U.S. 92, 106 (1938).

[89] See HUTCHINS, *op. cit. supra* note 5, at 403-07; NAT'L RESOURCES PLANNING BOARD, *op. cit. supra* note 19, at 19-21; HUTCHINS, *op. cit. supra* note 46, at 364-67; WELLS A. HUTCHINS, THE NEVADA LAW OF WATER RIGHTS 51-54 (1955), THE NEW MEXICO LAW OF WATER RIGHTS 38-42 (1955); THE IDAHO LAW OF WATER RIGHTS 83-85 (1956).

aged, and the participation of water users in water-management decisions will become extremely important. This prospect suggests the need for strong, locally-controlled resource-management districts which might carry out the local phases of river basin development usually under agreement with the developing agency. Since "rights" to use will be directly affected by management of water supplies, the direct administration of individual water rights by a state agency will become complicated and difficult. In such situations, the state may find it desirable to call upon local public districts for assistance in administering the individual water rights concerned, so that administration of rights and management decisions affecting water supply can be closely integrated.

IV

CONCLUSION

It is apparent that much of the water rights doctrine of this nation was designed to cope with problems that arose from individual efforts to develop and use natural water supplies. Because of both physical and economic factors, however, it has become increasingly clear that individual enterprise in this field must be more effectively supplemented by group and public efforts. In the light of these changing conditions, a reappraisal of the effectiveness of existing water law doctrines is in order.

The several doctrines that govern rights to the use of water, some of which have been centuries in the making, are based on either landownership or prior appropriation. The former group comprises the riparian doctrine with respect to watercourses, and the English, American, and correlative doctrines with respect to percolating ground waters—all of which accord rights to the use of water to certain land solely because of the land's contiguity to the source of water supply. Under the appropriation doctrine, on the other hand, water rights that pertain either to watercourses or to percolating ground waters are acquired by those who first divert the water and put it to beneficial use. In some states in which opposing systems—such as riparian and appropriation—are recognized, adjustment of conflicts has occupied the attention of courts and legislatures for many decades, and important problems still await solution. Each of the doctrines has certain advantages and disadvantages, depending on the point of view adopted—for the interest of the individual water user and that of the public at large are not always identical.

As consumptive use of water has increased, extant water law doctrines have been reexamined. In some western states, landownership doctrines—both riparian and ground water—have been eliminated in favor of exclusive appropriation systems; in others, these doctrines have been or are being modified to mitigate or remove their obstructive aspects. There is a movement in some of the riparian eastern states, too, toward certain aspects of the appropriation doctrine. For, riparian and other landownership principles are not well-suited to comprehensive river basin development, since the water rights must be acquired and merged with other rights involved. The appropriative principle, instead, would seem to be preferable, although it is not per-

fect, and much serious thought is being devoted to measures that will improve it for this purpose.

While the trend in both the West and the East toward more management and development of watersheds, rivers, and ground water has accelerated the adjustment of water rights doctrines, shifts in the use of water accompanying our expanding economy may also require adjustments, with due regard, of course, to constitutional requirements of due process wherever vested rights are involved. And in this connection, it seems inevitable that the interests of individual water users will come to be represented less and less by individual water rights acquired from the state and more and more by contracts with resource-management districts which will hold mass water rights in trust for the users.

As we look to the future, new technologies may increase water supplies through such innovations as increasing rain and desalting sea water, and these techniques may result in a great change in the economics of water use. In framing a model water code, one that will implement optimal river basin development, all of these possibilities—and, indeed, many others—must be considered.

A MODEL STATE WATER CODE FOR RIVER BASIN DEVELOPMENT

FRANK J. TRELEASE*

I

INTRODUCTION

River basin development generally calls to mind the Tennessee Valley, the Missouri Valley, the Colorado Valley—large areas, covering several states or parts of states. Attention focuses on the basin and on the role that rivers, once thought of as barriers, have come to play as nationally or regionally unifying forces. The over-all problems seem, at first blush, primarily to be federal ones that transcend purely state or local interest. But the fact is that rivers form and cross the boundaries of several states, and these states, thus, have exerted and will continue to exert a great influence on their development. Moreover, no matter how unified a "river basin plan" may appear to be as a whole, it is composed of many separate subbasins and projects which may be totally contained within a single state and which must be internally coordinated as well as externally related to the major basin plan.

River basin development, accordingly, is seen to be not an exclusively federal function consisting entirely of the large works constructed by the federal government on the major rivers. The states, their lesser governmental units, and private agencies, too, play an important role. Thus, some states even engage in the actual construction of projects, through such agencies as the Montana Water Conservation Board[1] and the state-created "authorities" that have developed the Texas coastal rivers.[2] Irrigation, conservancy, public-power, flood-control, and drainage districts also construct works that individually and in the aggregate make significant contributions to full river basin development.[3] And much activity is directed by private interests, ranging from the large coordinated projects of the major power companies, cooperative water companies, and major industrial users to the individual efforts of a single farmer who controls the water on his fields. For the most part, these public and private agencies operate under state law, and these institutional laws, consequently, have an important effect upon river basin development. But the state laws that have even greater influence are those dealing with the private water rights of individuals.

Some features of river basin development may, of course, depend wholly upon

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[1] See MISSOURI BASIN SURVEY COMM'N, MISSOURI: LAND AND WATER 82-83, 255 (1953).

[2] See Gideon, *Rights in Impounded Water*, in PROCEEDINGS OF THE WATER LAW CONFERENCES, UNIVERSITY OF TEXAS 263 (1954).

[3] See MISSOURI BASIN SURVEY COMM'N, *op. cit. supra* note 1, at 252-60.

federal law, where, for example, navigation, flood control, and federal power are involved, and state-created rights of water allocation must give way.[4] And the recently declared reservation of water rights for federally-owned lands that are not "public lands"[5] has raised other possibilities that the federal government may engage in development in the western states without regard to state laws.[6] Yet, absent such an overriding federal interest, the component parts of even a federal river basin development plan will be profoundly influenced by state water law. For, any agency planning a project for the control and use of water must do so with reference to certain putative beneficiaries; and the allocation of the water rights, the eligibility for these rights, and the exercise of these rights will, in most cases, be governed by the law of the state in which the water is controlled and used. Under some state laws, a federal or regional project may be difficult to plan, its costs may be increased, or its benefits may be restricted or reduced in value. Indeed, the very existence of the project may depend upon state water law.[7]

What kind of state water law, then, would best implement river basin development? Possibly germane considerations may be, of course, whether the law is to be for Arizona or Vermont, for the basin of the Missouri River or of Horseshoe Creek, for the industralized Connecticut Valley or the untamed reaches of the upper Colorado. Nevertheless, it is believed that some criteria can be defined that will have universal validity, the basic assumption being that all water allocation problems have one feature in common—there is not enough water for all possible uses, and some choice must be made among competing users or would-be users.

At the outset, the basic position propounded in this article should be stated: that prior appropriation, in the balance, seems to be the best extant system of law for river basin development in the United States. Let it be hastily added, however, that "prior appropriation" does not mean the uncontrolled exploitation of water resources by the first taker, nor the law of any particular western state, nor the expropriation of all riparian rights, nor any particular form of substitution of priorities for riparianism. Nor is prior appropriation the name for a homogeneous body of uniform law, for it

[4] United States v. Appalachian Electric Power Co., 311 U.S. 377 (1940); Oklahoma v. Guy F. Atkinson Co., 313 U.S. 508 (1941); United States v. Gerlach Livestock Co., 339 U.S. 725 (1950).

[5] FPC v. Oregon, 349 U.S. 435 (1955) (the United States can, without regard to state law, dispose of water rights in a nonnavigable stream that are applicable to both lands within Indian reservations and lands withdrawn from entry and reserved for power purposes). The Desert Land Act, 19 STAT. 377 (1877), as amended, 43 U.S.C. §§321 *et seq.* (1952), had been held to reserve all nonnavigable sources of water "on the public lands" for the use of the public under state law. California Oregon Power Co. v. Beaver Portland Cement Co., 295 U.S. 142 (1935). See *Hearings before the Subcommittee on Irrigation and Reclamation of the Senate Committee on Interior and Insular Affairs on S. 863,* 84th Cong., 1st Sess. (1956).

[6] Treaties with foreign nations and the Indian tribes may create other opportunities for federal development independent of state law. See Note, 17 ROCKY MT. L. REV. 251 (1945); United States v. Ahtanum Irri. Dist., 236 F.2d 321 (9th Cir. 1956).

[7] The Secretary of the Interior, in carrying out the provisions of the Reclamation Act of 1902, must proceed in conformity with state laws relating to the control, appropriation, use, and distribution of water. 32 STAT. 390, 43 U.S.C. §383 (1952). In all but two of the seventeen western states to which the act is applicable, this involves the procuring, by the Secretary, of a permit from the state water officials. See Rank v. (Krug) United States, 142 F. Supp. 1, 124 (S.D. Cal. 1956).

exhibits wide variations in the laws of the western states. Moreover, some of its manifestations are good; some are bad—at least some seem less well designed than others to accomplish the maximum and optimum development of water resources; and some are obviously not suitable for transplantation to the East. But within this large body of law are rules, techniques, and devices with which to meet every criticism leveled at the generalized concept of "prior appropriation," whether the criticism is directed at existing doctrine in the West or at the doctrine as a solution for eastern problems raised by riparian law. In other words, western appropriation could be improved in many ways, and the best of this law could be used as a model by any state to meet its local needs. The West has had a century of experience with water shortages; the East is just beginning to fear them. The doctrine of prior appropriation has shown that it contains elements of remarkable flexibility and an ability to grow. It has made the transition from a pioneer system of acquiring water rights to a modern system of state control of water resources.[8] Practically every suggestion yet made for the improvement of eastern water law has been based upon ideas, techniques, or practices now current in the West.[9]

II

MAXIMUM DEVELOPMENT

The first prerequisite of a model state system of water law is that it should encourage, or at least not deter, maximum development. The most severe criticism of riparian law has been leveled at its shortcomings on this score, particularly with regard to its limitations on the place of use of water. Since the ownership of adjacent land is the basis of the riparian right, a stream's waters are reserved for the use of owners of tracts located on its banks, and usually for use on such land.[10] A further limitation is that regardless of the extent of the riparian ownership, the use must be within the watershed of the stream.[11] Of course, use by nonriparians or by riparians beyond the watershed is not proscribed completely, but it exists in spite of rather than because of riparian laws—either because the riparian has no use for the water,[12]

[8] Lasky, *From Prior Appropriation to Economic Distribution of Water by the State*, 1 ROCKY MT. L. REV. 161 (1928).

[9] See Ellis, *Some Current and Proposed Water-Rights Legislation in the Eastern States*, 41 IOWA L. REV. 237 (1956); Marquis, Freeman, and Heath, *The Movement for New Water Rights Laws in the Tennessee Valley States*, 23 TENN. L. REV. 797 (1955); Coates, *Present and Proposed Legal Control of Water Resources in Wisconsin*, 1953 WIS. L. REV. 256; Barlowe, *Proposed Water Rights Legislation in Michigan*, 26 LAND ECON. 300 (1950). Most of these papers contain cautious reservations and suggestions for further study. Haar and Gordon, *Legislative Change of Water Law in Massachusetts: A Case Study of the Consequences of Introducing a Prior Appropriation System*, in SYMPOSIUM ON THE LAW OF WATER ALLOCATION IN THE EASTERN UNITED STATES (to be published by The Conservation Foundation 1957), is a spirited defense of riparianism; yet, it suggests an eastern state might profit from securing some of the benefits of a water administrative agency, injecting into determinations of reasonable use factors of priority, protection of investment, and social utility, and perhaps discarding the watershed limitation on use of water.

[10] Stratton v. Mt. Hermon Boys' School, 216 Mass. 83, 103 N.E. 87 (1913).

[11] *Ibid.*

[12] Ulbricht v. Eufaula Water Co., 86 Ala. 587, 6 So. 78 (1889).

because there is no shortage,[13] because the riparian has been bought out,[14] or because prescriptive rights have intervened to protect the user.[15] As for the extent of the use that can be made by the riparian, however, the old "natural flow" rule, which permitted lower riparians to enjoin uses resulting in substantial diminutions of the stream, is today regarded principally as a bugaboo found in old opinions or in ambiguous dicta.[16] The inutility of this doctrine is so offensive to the modern mind, in the light of the modern emphasis on maximum development, that it is not thought to present any serious obstacle. The modern rule, certainly the modern trend, is to permit all reasonable uses, regardless of the amount of water consumed, with reasonableness being measured either by the lack of damage to others or by the relative insignificance of the damage compared to the value of the use.[17] As long, then, as the development is on riparian land, riparian law is no deterrent.

In contrast, the appropriative doctrine generally encourages development anywhere. The basic tenet of the doctrine is that beneficial use is the basis of the right. Wherever there is need for water, whoever needs it, can be applied to serve the demand. The case that first applied the rule of appropriation to a dispute between the gold miners on the western public domain[18] and the case that first propounded the "Colorado Doctrine" of basing all state water rights on prior appropriation[19] both approved diversions from one stream across the divide for use in the watershed of another, and the rule permitting this practice has been regarded as almost universal.[20]

Yet, there are backwaters in the stream of prior appropriation; in some western states, restrictions on the place of use of appropriated water have been imposed. Colorado has prohibited conservancy districts planning the exportation of water from the Colorado River to the eastern slope of the continental divide from impairing or increasing in cost any present or prospective appropriation for use within the basin of the river.[21] California, in setting up a state agency to construct the Central Valley Project, provided that a watershed or adjacent area which can be conveniently supplied with its water shall not be deprived of the prior right to all the water required to supply the beneficial needs of the watershed or area.[22] Another California law permits a state agency to file applications for priorities that are, in effect, reservations of water for a long-range state water plan, but use under this plan may not deprive the county in which the water originated of any water necessary for the development of the county.[23] These "watershed of origin" and "county of origin" statutes

[13] Elliot v. The Fitchburg Railroad Co., 64 Mass. (10 Cush.) 191 (1852).
[14] Texas Co. v. Burkett, 117 Tex. 16, 296 S.W. 273 (1927).
[15] Martin v. Burr, 111 Tex. 57, 228 S.W. 543 (1921).
[16] See Marquis, Freeman and Heath, *supra* note 9.
[17] See RESTATEMENT, TORTS §§852-54 (1939).
[18] Irwin v. Phillips, 5 Cal. 140 (1855).
[19] Coffin v. Left Hand Ditch Co., 6 Colo. 443 (1882).
[20] Wyoming v. Colorado, 259 U.S. 419 (1922). The most notable exception is in Nebraska. See Osterman v. Central Nebraska Public Power & Irri. Dist., 131 Neb. 356, 268 N.W. 334 (1936). And an ambiguous Texas statute leaves the rule in that state in doubt. TEX. REV. CIV. STAT. art. 7590 (1948).
[21] COLO. REV. STAT. ANN. §149-6-13 (1953).
[22] CAL. WATER CODE ANN. §§11460, 11463 (West 1956).
[23] *Id.*, §10505.

have been held applicable to the federal projects which have supplanted the earlier state enterprises.[24] To the extent that these are thoughtful exceptions, preserving waters from immediate use in order to reserve them for a better future use, they may be wise laws. But to the extent that they reflect local pressures for preferred treatment, making blanket reservations of water for the uncertain future uses of the residents of the basin, they may foreclose valuable and needed projects which would otherwise be feasible under modern engineering methods.

Another type of political restriction on place of use, which may have a special impact on river basin programs, involves interstate appropriations. In many early appropriations on interstate streams, the water was diverted in one state, transported across the state line, and used in another. Such rights were universally upheld;[25] but many states, in an excess of localism, have adopted statutes that restrict this practice. The most extreme law is that of Colorado, which, for the expressed purpose of preserving all of the water within the state for the use of the state and its citizens, absolutely prohibits the transportation of water found in Colorado into any other state.[26] More typical statutes permit appropriations for out-of-state use if the state in which the use is to be made grants reciprocal privileges or if the legislature gives specific approval to each such diversion.[27] Statutes such as Colorado's are obviously undesirable from the standpoint of river basin development, and even the more liberal statutes seems out of place today. Developments in one state, where the slope of the land dictates a diversion point in another, should not depend upon the grace of unilateral action by the state in which the diversion is made. More properly, the problem is one of allocating water between states, a problem better settled by the method of interstate compact.

Laws which protect wasteful practices are certainly not conducive to maximum development. The policy of the law in the arid states is to compel an economical use of water; a prior appropriator should not be able to block future beneficial uses by insisting on receiving more water than is absolutely necessary for his purpose. The courts have not, however, firmly adhered to this policy in all cases; in some, they have given it little more than lip service.[28] Early irrigation decrees were often for atrociously large quantities of water, and many of these are still in effect. They do not prevent today's courts and water officials from restricting the use under them in accordance with modern standards.[29] Similarly, transmission losses might be given a modern treatment. If an appropriator's ditch is very long or the soil through which it is dug is every porous, a considerable amount of water will be

[24] Rank v. (Krug) United States, 142 F. Supp. 1 (S.D. Cal. 1956).

[25] Willey v. Decker, 11 Wyo. 496, 73 Pac. 210 (1903); Lindsey v. McClure, 136 F.2d 65 (10th Cir. 1943).

[26] COLO. REV. STAT. ANN. §§147-1-1, 147-1-3 (1953).

[27] *E.g.*, UTAH CODE ANN. §73-2-8 (1953); WYO. COMP. STAT. ANN. §71-265 (1945).

[28] *Compare* State v. Birdwood Irri. Dist., 154 Neb. 52, 46 N.W.2d 884 (1951), *with* Joerger v. Pacific Gas & Electric Co., 207 Cal. 8, 276 Pac. 1017 (1929).

[29] See Quinn v. John Whitaker Ranch Co., 54 Wyo. 367, 92 P.2d 568 (1939); Tudor v. Jaca, 178 Ore. 126, 165 P.2d 770 (1946).

lost by evaporation and seepage between the point where it is diverted from the stream and the place of use. In some states, an allowance is made for a reasonable amount of such losses in transmission;[30] in others, the amount needed at the place of use is measured out to the appropriator at the point of diversion.[31] In early times, the latter rule would have been unrealistic, but today it may have salutary effects, since appropriators will be encouraged to line their ditches and otherwise improve their facilities, so that water will be more economically used and more land can be brought under irrigation. States where water is especially precious might well give some thought to this problem.

A related problem arises from stream transmission losses. In the settlement of the West, the lands first taken up were frequently located on the lower reaches of streams that lost much of their water into the ground as they flowed over gravelly and porous beds. Appropriations made in such locations, thus, may preclude full use of the water that is available upstream, for the lower appropriator's priority will be protected if any usable quantity will reach his point of diversion, even though this means that the junior is forced to let a much larger quantity flow past his headgate.[32] This rule has been criticized as unduly wasteful of the natural resource.[33] The solution to the problem may be economic, in that if the benefits that would accrue from upstream use are, in fact, much greater than those realized by the senior appropriator, it would seem feasible for the upstream user to buy out the lower prior rights and transfer the use upstream. But legal solutions may be possible in the form of rotation systems that would more equitably spread the benefits of the water,[34] or physical solutions might be imposed if it can be found that underground sources fed by upstream irrigation will supply the downstream priorities.[35]

Another important factor in the encouragement of development is the minimization of costs. Under a prior appropriation system, if there is unappropriated water available, the costs of development are encompassed within the framework of the project itself, the physical works needed to utilize the water. Under a riparian system, there may be an added cost in procuring a firm supply, even where the water is not presently being used. A prospective riparian or nonriparian user, seeking a firm supply, may have to buy his peace from a number of other riparians, either on the open market or, if a public use is involved, by condemnation. Of course, if stability in advance is not obtained by grant and water rights are sought to be purchased after the user finds himself in trouble because he is now infringing

[30] NEV. COMP. LAWS §7899 (1929); N. D. REV. CODE §61-1403 (1943).

[31] Stickney v. Hanrahan, 7 Idaho 424, 63 Pac. 189 (1900); *In re* North Loup River Public Power & Irri. Dist., 149 Neb. 823, 32 N.W.2d 869 (1948).

[32] Raymond v. Wimsette, 12 Mont. 551, 21 Pac. 537 (1892); State *ex rel.* Cary v. Cochran, 138 Neb. 163, 292 N.W. 239 (1940).

[33] Fisher, *Western Experience and Eastern Appropriation Proposals*, in SYMPOSIUM ON THE LAW OF WATER ALLOCATION IN THE EASTERN UNITED STATES (to be published by the Conservation Foundation 1957).

[34] See Dameron Valley Reservoir & Canal Co. v. Bleak, 61 Utah 230, 211 Pac. 974 (1922); Albion-Idaho Land Co. v. Naf Irri. Co., 97 F.2d 439 (10th Cir. 1938).

[35] See Fisher, *supra* note 33.

the reasonable uses of riparians, the value of the water right may be the price of buying the riparian's forebearance to enjoin the use, a price which may well be what it is worth to the nonriparian to continue his development.[36]

III

SECURITY

A system of water law that would promote and encourage maximum development must offer to the water user security for his investment in facilities. Security of water rights has been recently analyzed in a most interesting fashion by an economist,[37] who points out that the concept actually involves three quite different things: (1) legal certainty, the protection against unlawful acts, subject to the "rule uncertainty" and "fact uncertainty" inevitably involved in legal conflicts; (2) physical certainty, the protection against variation in the quantity of water available for the use; and (3) tenure certainty, protection against the loss of the water right by the exercise of lawful acts by others. In all of these aspects, appropriative rights seem to offer advantages over riparian rights.

The legal protection given by a system of water law is difficult to measure. In one respect, the system of water masters or commissioners charged with the duties of distributing water according to priorities gives greater protection to the western appropriator than does the lawsuit which is the sole resort of the riparian. The appropriator, in other words, has a policeman on the beat.[38] The subsidiary factor of rule uncertainty, the inability to predict which of several lines of authority a judge will follow, seems greater under riparian law. In some jurisdictions, there may be the fear that the "natural flow" rule will be invoked by a court to stop a development that materially diminishes the stream, especially if the development is nonriparian.[39] In many states, there is doubt as to the extent of riparian land,[40] the permissible scope of irrigation,[41] and the extent to which storage for power and other operations is permissible.[42] There is also the ever-present combination of rule and fact uncertainty involved in the determination of reasonable use.[43] Of course, there are rule uncertainties in

[36] See Bingham, *California Law of Riparian Rights*, 22 CALIF. L. REV. 251 (1934) (practice described as blackmail).

[37] Wantrup, *Concepts Used as Economic Criteria for a System of Water Rights*, 32 LAND. ECON. 295 (1956).

[38] See Lasky, *supra* note 8. This is, perhaps, a feature of administration rather than basic law, a feature that may not be entirely suitable to eastern development. See Marquis, *Remarks*, in SYMPOSIUM ON THE LAW OF WATER ALLOCATION IN THE EASTERN UNITED STATES (to be published by the Conservation Foundation 1957).

[39] See 4 RICHARD R. B. POWELL, REAL PPROPERTY 359, 372 n. 2 (1956).

[40] See Haar and Gordon, *supra* note 9; Arens, *Michigan Law of Water Allocation*, in SYMPOSIUM ON THE LAW OF WATER ALLOCATION IN THE EASTERN UNITED STATES (to be published by the Conservation Foundation 1957).

[41] See Ellis, *Some Legal Aspects of Water Use in North Carolina*, SYMPOSIUM ON THE LAW OF WATER ALLOCATION IN THE EASTERN UNITED STATES (to be published by the Conservation Foundation 1957); Arens, *supra* note 40.

[42] See Herminghaus v. Southern California Edison Co., 200 Cal. 81, 252 Pac. 607 (1926); Moore v. California Oregon Power Co., 22 Cal.2d 725, 140 P.2d 798 (1943); Lone Tree Ditch Co. v. Rapid City Electric Co., 16 S.D. 451, 93 N.W. 650 (1903).

[43] See Haar and Gordon, *supra* note 9; Arens, *supra* note 40; Ellis, *supra* note 41.

appropriation law as well, but most of the choice-of-law problems are met by statutes, and in working out a modern water code, these choices can be made.

The control of physical uncertainty is obviously not entirely in the hands of the lawmakers; creeks and even rivers dry up during long periods of drought. But the uncertainty of the supply of water for a particular use is affected by the type of right held for that use. Physical uncertainty is minimized for early appropriators, yet magnified for junior appropriators; for, by the principle of priority, the senior receives the full quantity of his appropriation, shifting the risk of stream variation to the junior, whose supply may be shut off entirely. Under riparian law, with its equality of right, water users with the same or equal reasonable uses may all be granted some water in times of shortage, although there is no assurance that each will receive enough to make his operation worthwhile. Although equality of right has a democratic sound and a surface appeal to most people, an equal share of a supply insufficient for all may be so small as to be insufficient for each. But the risk of physical uncertainty is not always borne equally by all riparians. What might be a reasonable use in good water years may become highly unreasonable in times of drought,[44] and some riparians may, thus, lose their right temporarily.

But a true idea of the physical certainty obtainable under appropriation law cannot be based on a picture of the water commissioner marching up and down the stream, shutting off the ditches of junior appropriators as the flow drops during the summer months. Through the coordination of modern engineering science and modern developments in the law of prior appropriation, a stability can be reached that cannot be matched under riparian law. The hardship to the junior appropriator resulting from varying stream flows was first alleviated by developing reservoirs to hold spring floods for use later in the season. As the streams were found to fluctuate from year to year, larger reservoirs were built to carry over water from the good years and provide a supply in times of drought. And often, a good supply can be found in a neighboring watershed less blessed with agricultural land or industrial opportunities. Much stored water and much water imported from other basins, accordingly, is today applied supplementally to lands originally dependent upon junior diversions of direct stream flow. In these ways, the supply may be firmed up and the variations minimized. Appropriation principles are more conducive to these water development projects that alleviate this uncertainty of supply—projects that are usually the heart of river basin development. Under statutes regulating new appropriations, which provide for the denial of permits if there is no unappropriated water in the source of supply, appropriations may be granted to the limit of the available water, giving both senior and junior a firm right to a firm supply.[45] But even if a firm supply

[44] Meng v. Coffey, 67 Neb. 500, 93 N.W. 713 (1903).

[45] This seems to be the goal toward which the practice under the law of prior appropriation is moving. Admittedly, much unstable junior development has occurred in the past; but many of today's projects are for the purpose of giving a supplemental supply to such insecure water uses. In the groundwater field, there is much emphasis on restricting the issuance of pumping permits in new areas to the safe yield of the aquifiers. WASH. REV. CODE §90.44.070 (1951); ORE. REV. STAT. §537.735 (1955). *Cf.* Harris, *Water Allocations under the Appropriation Doctrine in the Lea County Basin of New*

is achieved in a valley governed by riparian law, there is no legal limit to the riparian's demands, and if too many choose to participate, or if demands increase, the firm supply may become insufficient to satisfy all rights.

As for certainty of tenure of water rights, the appropriative right seems, again, to be preferable. It has been defined as a vested right to take and divert from the source a particular quantity of water annually forever.[46] The right is clearly defined as to priority, quantity, period of use, and point of diversion. The senior appropriator is protected against invasions by later takers, and the junior appropriator is protected against enlargement of the uses of senior appropriators.

The perpetual nature of an appropriative right is subject to one qualification, stemming from the utilitarian nature of the doctrine—if it is not used, the water right is lost by operation of the rules of abandonment and forfeiture.[47]

The right is also subject to termination under powers of eminent domain, but security of investment is not thereby impaired, since compensation for the value of the use is substituted for the expectations from the continuation of the use. Most western preference laws, sometimes thought to be threats to the security of appropriations, are, in fact, applications of the eminent domain principle.[48] It is true that there are possibilities of destruction of vested appropriative rights by the exercise of other types of preferences that do not involve compensation, but there are few instances where legislatures have adopted these, and new preferences of this order may not constitutionally apply to existing rights.[49] Of course, tenure certainty increases if the particular right stands high in the order of preferences.[50]

Riparian rights are also perpetual, subject to divestment by preferences, such as a city's exercise of eminent domain for municipal uses. But a particular use of the right is always subject to future determination of its reasonableness in view of later needs for the water, and even though the use is reasonable, the right gives no guarantee of a certain quantity of water as others with equal rights demand a share.

It may be possible to obtain security under the riparian system through purchases of water rights or of releases from riparians. One difficulty with this approach, however, is that, to a large extent, the certainty desired by the prospective water user can rarely be obtained from a single seller. If the prospective user is a riparian intending to use a large amount of water, he may have to get grants or releases from a large number of other riparians in order to accumulate enough rights attached to enough land to insure that future reasonable uses on other lands will

Mexico, in SYMPOSIUM ON THE LAW OF WATER ALLOCATION IN THE EASTERN UNITED STATES (to be published by the Conservation Foundation 1957), discussing the restriction of permits to pump from a nonreplenishable basin in order to prevent its exhaustion before investments could be amortized.

[46] Arizona v. California, 283 U.S. 423 (1931). Such a definition, of course, implies no guarantee of the continuation of the source of supply. See Harris, *supra* note 45.

[47] See notes 89-91 *infra*.

[48] See Trelease, *Preferences to the Use of Water*, 27 ROCKY MT. L. REV. 133 (1955).

[49] *Ibid.*

[50] See Wantrup, *supra* note 37.

always leave him a supply. If the developer is a nonriparian, in most states he cannot buy from one riparian a right to use the water that will be good against other riparian proprietors. The riparian seller of the "water right" has no right to use the water on nonriparian land, and he can sell no such right.[51] Nevertheless, a large number of so-called transfers of riparian rights have been made to nonriparians. The reason is that such grants are binding between the parties[52] and operate as an estoppel against the grantor, preventing him and his successors in title from complaining of the nonriparian use.[53] They may, therefore, enable a nonriparian to buy out some of the larger riparian proprietors and, hence, serve a legitimate purpose in insuring him a sufficient supply of water.

A few states give full effect to a grant of riparian rights, even as against other riparians. The grantee's right is regarded as a derivative one, to be measured by the extent of the right of the riparian proprietor,[54] and the grantee obtains a right to a reasonable use of the stream as if he were substituted for the riparian. But the right that he obtains is subject to variation in relation to the quantity of the flow and the reasonable demands of other riparians, and the goal of stability has not been reached.

Another method of obtaining some security under riparian law is by prescription. When the old "natural flow" theory was in force, so that any substantial withdrawal from the stream was a violation of a lower riparian's rights, although it did him no harm, such rights were easy to obtain, for the simple reason that people do not often start lawsuits unless they are hurt.[55] However, where the reasonable use theory is applied, the prescriptive period will not begin to run until actual damage results from an unreasonable interference with the uses of the riparian.[56] Therefore, the continuous use either by an upper riparian or by a nonriparian of a certain amount of water each year creates no prescriptive rights as against a lower riparian as long as there is no actual clash between their rights;[57] and in the ordinary case, no prescriptive right can be obtained by a water user against riparians situated upstream from the point of diversion, however long the use continues, for such downstream use gives the upper riparian no cause for complaint or redress.[58] In any event, the doctrine of prescriptive rights is hardly a satisfactory solution to the problem of a water user who seeks a firm right. The risk involved in investing one's money in a development, then "sweating out" the prescriptive period in the hope that no action will be brought is too great.

One aspect of physical insecurity, that has already grown acute in some areas

[51] Crawford Co. v. Hathaway, 67 Neb. 325, 93 N.W. 781 (1903); Duckworth v. Watsonville Water & Light Co., 150 Cal. 520, 89 Pac. 338 (1907). See Annot., 14 A.L.R. 330 (1921).

[52] Texas Co. v. Burkett, 117 Tex. 16, 296 S.W. 273, 54 A.L.R. 1397 (1927).

[53] Duckworth v. Watsonville Water & Light Co., 150 Cal. 520, 89 Pac. 338 (1907).

[54] Smith v. Stanolind Oil & Gas Co., 197 Okla. 499, 172 P.2d 1002 (1946).

[55] See Shaw, *The Development of the Law of Waters in the West*, 10 CALIF. L. REV. 443 (1922).

[56] Pasadena v. Alhambra, 33 Cal.2d 908, 207 P.2d 17 (1949).

[57] Pabst v. Finmand, 190 Cal. 124, 211 Pac. 11 (1922).

[58] Cory v. Smith, 206 Cal. 508, 274 Pac. 969 (1929). See Trelease, *Coordination of Riparian and Appropriative Rights to the Use of Water*, 33 TEXAS L. REV. 24 (1954), for some exceptions to this rule.

of the West and is a potential threat in the East deserves special mention. This is the problem of the loss of substantial quantities of stream flow to those who pump the underground waters that feed the streams. Most water development in the past has been accomplished through utilization of the waters of surface streams, but in recent years, the use of pumped underground water has grown tremendously. In periods of deficient rainfall, the low water flows of the streams and rivers must supply the most urgent riparian needs and the earliest priorities; yet, the streamflow in such periods is derived chiefly from ground-water.[59] It is, therefore, obvious that there must be some correlation between the laws regulating the use of surface streams and those regulating the use of water from the contributing ground-water reservoirs. This is possible in states where the same rule of allocation is applied to both classes of water, as in those western states which have the rule of prior appropriation for both, or as in California where the correlative rights doctrine applied to underground waters is practically identical to the combination of riparianism and appropriations for surface streams.[60] But where the allocation rules are different and ground waters may be withdrawn by the owner of the overlying soil on the basis either of absolute ownership or of reasonable use in relation to his needs, while stream waters are allocated on the basis of priority or reasonable use related to the demands of others, no protection can be given to the stream owner unless the courts seize upon the legal fiction of an "underground stream."[61]

There is danger, moreover, even in states applying the same rule of allocation to both types of water, that the courts or officials may not recognize the unity of the hydrologic cycle and may attempt to treat interrelated sources as separate entities. It has been suggested, therefore, that statutes further be enacted providing for a correlated list of priorities from different bodies of water so interconnected as to constitute, in fact, one common source of supply,[62] although this, in itself, would not be enough. Security of rights to stream waters might, however, be increased by requiring users of underground waters to cease pumping from wells that interfere with surface flows. But in many situations, the low water flows are merely a surface manifestation of an extremely large body of water supporting the stream,[63] and to revert

[59] See Thomas, *Hydrology v. Water Allocation in the Eastern United States*, in SYMPOSIUM ON THE LAW OF WATER ALLOCATION IN THE EASTERN UNITED STATES (to be published by the Conservation Foundation 1957). It is reported that in the Platte and Arkansas Valleys of Colorado, three times as much water must now be sent downstream to supply senior rights as was delivered before irrigation wells were drilled in the valleys. Denver Post, Nov. 18, 1956, Roundup Section, p. 3, col. 1.

[60] Wrathall v. Johnson, 86 Utah 50, 40 P.2d 775 (1935); Hinton v. Little, 50 Idaho 371, 296 Pac. 582 (1931); Katz v. Walkinshaw, 141 Cal. 116, 70 Pac. 663 (1903).

[61] Verdugo Canon Water Co. v. Verdugo, 152 Cal. 655, 93 Pac. 1021 (1908); Maricopa County Municipal Water Conservation Dist. v. Southwest Cotton Co., 39 Ariz. 65, 4 P.2d 369 (1931). For the Texas experience, see Pecos County Water Control & Improvement Dist. v. Williams, 271 S.W.2d 503 (Tex. Civ. App. 1954), in which well drillers asserting ownership of underground waters were permitted to destroy, without liability, a stream that had supplied appropriators for ninety years.

[62] NAT'L RESOURCES PLANNING BOARD, STATE WATER LAW IN THE DEVELOPMENT OF THE WEST 83, 128 (1943).

[63] In Colorado, examples are the Frenchman Creek area, where pumping 100,000 acre-feet of water per year would deplete stream flow by only 15,000 acre feet, and Beaver Creek, where stopping the pumping of 20,000 acre-feet would produce only 1,000 acre-feet of streamflow. See Denver Post, Nov. 18, 1956, Roundup Section p. 9, col. 2.

to the interest in maximum development, some compromise must be found which will permit the use of these vast basins of underground water, yet, at the same time, protect, to the greatest possible extent, the rights of users from surface streams.

A clue to such a compromise may be found in the present appropriation laws. In no western state can a prior appropriator insist that conditions on the stream remain the same as they were when he made his appropriation. Though a simple ditch cut into the bank may have sufficed at first, he cannot skim the cream off the river and insist that it all flow by to raise the water to the level of his ditch; a diversion dam must be installed to carry into effect his use and, at the same time, permit junior uses of the rest of the stream that formerly supported his water up to the intake. In some states, he must, as development progresses, install, at his own expense, diversion works consistent with the maximum development of the waters of the stream, so that he as well as the latecomer bears a share in the cost of total development.[64] In others, he may shift the burden of the cost of improvement to the junior,[65] or must at least permit a junior appropriator to change his method of diversion at the junior's expense and install more economical means, if all of his rights to water are preserved and maintained.[66] Borrowing a page from this surface water law may solve the instant problem. The supporting subflow may be likened to the full streamflow that once carried the pioneer's water to his ditch; a change of means of diversion is now required so that both senior stream appropriator and junior ground-water appropriator can get their water. This can be done by requiring the senior to substitute wells for his ditch, without loss of priority, at his own cost or at the expense of the junior, whichever may seem most desirable.

One last point should be made with reference to tenure certainty. In order to achieve maximum security, a state water law should provide adequate and efficient procedures for initiating, adjudicating, and recording water rights. Much emphasis has been placed, in recent writings, upon the necessity for collecting the basic data of streamflow and hydrology necessary for adequate planning. One absolutely essential datum for planning future projects, however, is the amount of present use of water and the total of existing claims to the water. In most of the western states, this can readily be ascertained. Early in the history of western appropriation, it was found that the ordinary lawsuit was an inadequate method of settling water titles, and statutory procedures were devised for bringing all claimants to the stream into court. These court procedures are still used in Montana and Colorado, and only Texas has the lawsuit;[67] but in the rest of the states with appropriation laws, administrative procedures have been substituted, based upon actual stream studies, surveys

[64] *In re* Owyhee River, 124 Ore. 44, 259 Pac. 292 (1927).

[65] State *ex rel* Crowley v. District Court, 108 Mont. 89, 88 P.2d 23, 121 A.L.R. 1031 (1939). Salt Lake City v. Gardner, 39 Utah 30, 114 Pac. 147 (1911). A strong argument for the proposition that the senior should bear the cost of the improvement is found in the concurring opinion of Latimer, J. in Hanson v. Salt Lake City, 115 Utah 404, 439, 205 P.2d 255, 272 (1949).

[66] Clausen v. Armington, 123 Mont. 1, 212 P.2d 440 (1949); Big Cottonwood Tanner Ditch Co. v. Shurtliff, 56 Utah 196, 189 Pac. 587 (1919).

[67] See Lasky, *supra* note 8.

of land, and inspection of water uses. In Wyoming, Nebraska, and Kansas, the administrative agency carries the proceedings through to final adjudication,[68] but to avoid the objection that judicial powers are thus exercised by executive agencies, most of the states provide for a court decree based upon the administrative findings.[69] All of these procedures give actual or published notice to every claimant of an interest in the stream, requiring him to come in and state his claim, and all end in a final adjudication effectively barring those who do not appear from making any claim to the waters, except as a subsequent appropriator.[70] In those states in which riparian and appropriative rights exist, the rights of riparians have been adjudicated along with those of appropriators.[71]

The determination of past rights is not enough, however; the record must also be kept up-to-date by procedures for initiating water rights or recording them as they are initiated. The system of permits to appropriate, common in the West, accomplishes this effectively, but it must be followed up with procedures for ripening the permit into a license upon application of the water to beneficial use, otherwise there is no way of telling which permits have been actually followed by development.

This is not to say that all western appropriative states have adequate procedures. In some states there are "paper rights" to waters that have never been applied to beneficial use or that represent uses long since abandoned. Examples are the certified fillings and permits issued by the Texas Board of Water Engineers, totaling at least four times the amount of water in actual use, and permits and certificates issued in Oregon covering twice the acreage actually irrigated.[72] Ineffective abandonment and forfeiture procedures are responsible for this condition. In Wyoming, the courts have, with understandable reluctance, hesitated to declare that a person has forfeited his rights, but going beyond simple protection of the appropriator, they have placed restrictions upon abandonment procedures that make them almost impossible of enforcement. It is held both that these proceedings can be initiated only by a water user who can clearly show that he will be directly benefited by the water, a condition extremely hard to prove on a fluctuating stream, and that the complaint of forfeiture must be brought within the period of limitations, which begins to run at the time of the abandonment, although the necessity for litigation would not normally occur to other appropriators until the use of the water was resumed. In addition, if the use of the water is resumed before the cancellation proceedings are initiated, the right is revived.[73] Such "stale claims" have created considerable uncertainty both for existing appropriators and would-be new users needing to know the amount of water covered by valid rights senior to theirs.[74]

[68] *Ibid.*; see also KAN. GEN. STAT. §82a-708 (1949).
[69] See Lasky, *supra* note 8.
[70] *Ibid.*
[71] See Trelease, *supra* note 58.
[72] See Fisher, *supra* note 33.
[73] Horse Creek Conservation Dist. v. Lincoln Land Co., 54 Wyo. 320, 92 P.2d 572 (1939); Sturgeon v. Brooks, 73 Wyo. 436, 281 P.2d 675 (1955).
[74] See Fisher, *supra* note 33; Note, *Stale Claims in Texas Stream Waters*, 28 TEXAS L. REV. 931 (1950).

IV

FLEXIBILITY

On the score of flexibility, prior appropriation has received the criticism and riparianism the praise. Charges of fixity, of freezing existing patterns of resource use, and of restricting industrial growth are preferred against the doctrine of appropriation,[75] and with some justification. Typically, an appropriation is regarded as a grant for a particular use forever; and the earliest and most stable water rights are, thus, tied to the pioneer economy, leaving modern developments to take their place at the foot of the priority list, with the least assurance of a firm water supply. And in some states, restrictions on transfers of water rights to new uses or places of use seems further to insure this result. Under riparian law, on the other hand, flexibility is achieved by permitting new riparian users of the water to compete on an equal footing with the old. The highest economic use of water may receive judicial recognition as the most reasonable, and at any time, a court may reshuffle the water rights to exclude old uses as no longer reasonable and to permit new uses. There is, however, no guarantee that the new uses are more economical or suitable than the old,[76] and the price of this flexibility is insecurity, for such riparian transfers are made without compensation.

But flexibility and stability are not necessarily antipodal, and only in some states are appropriations inflexible. It is possible for appropriative protection of investment to exist along with freedom of transfer of water rights. If the desired flexibility is voluntary transferability with compensation, to permit new uses to bid freely for water on the market in competition with other new or old users, the appropriative rights of some states are ideally suited for this purpose. Originally, the appropriations acquired on the public domain of the West were regarded as freely salable, and this is still the rule in some states.[77] In Colorado, for instance, the use of the water is not limited to the land where the water was first applied, and a water right may be alienated apart from the land, its use transferred from one place to another, or even the character of the use changed, so long as such change does not result in the use of a larger quantity of water than the right calls for.[78]

On the other hand, some states prohibit the change of water used for irrigation from the lands for which it was originally appropriated, except when, for natural causes beyond the control of the owner, it becomes impracticable beneficially or economically to use the water for the irrigation of the original land.[79] Such laws prohibit the transfer of water rights from relatively poor to more fertile lands, re-

[75] Marquis, Freeman, and Heath, *supra* note 9; NAT'L RESOURCES PLANNING BOARD, *op. cit. supra* note 62, at 45.

[76] See Arens, *supra* note 40.

[77] See W. A. HUTCHINS, SELECTED PROBLEMS IN THE LAWS OF WATER RIGHTS 38-384 (1942).

[78] Hassler v. Fountain Mutual Irri. Co., 93 Colo. 246, 26 P.2d 102 (1933). The right to make such a change is subject to the restriction that no damage to the rights of other appropriators may result. Typically, this prevents changes that would deprive downstream users of the benefits of return flow.

[79] See HUTCHINS, *loc. cit. supra* note 77.

quire an appropriator for new lands to take his place at the bottom of the priority list, and prevent him from purchasing a firm water right, although he is able to do so. The purpose behind these restrictive statutes seems to have been to prevent abuses that arose from the transfer of some old water rights. Many early adjudications gave irrigators far more water than they really needed, so that the appropriator not infrequently sold his unused water, to which he really had no right.[80] To avoid such abuses and to insure the protection of some interests, such as recreation, that cannot bid for water on the market, the control of such transfers might be left in the lands of an agency that would allow all such changes unless it affirmatively appeared that the public interest would be prejudiced.[81]

Such transfers of appropriative rights offer many advantages over deeds and releases of riparian rights. The purchaser gets a right to a fixed quantity of water, tenure certainty, and as firm a right in terms of physical certainty as he is willing to pay for, depending upon where the right he purchases fits into the priority list. He does not need to buy riparian land nor move his operation to the river bank.

If the flexibility desired is the power to force involuntary changes from one use to another, with compensation, again appropriation seems to have the advantage. As previously noted, most western preference statutes create rights of condemnation and permit the exercise of the preference only if the prior nonpreferred appropriator is paid full compensation for the loss of his water. Thus, flexibility is achieved without confiscation of investment, for although the nonpreferred user loses the use of the water, he does receive its value. Such preferences may insure the economic growth of certain types of water use deemed desirable when the statutes were enacted, but admittedly, most of today's preferences embody the economic thinking of yesterday.[82] To the extent that a legislature, perhaps under the guidance of a planning agency, can foresee that a certain purpose is now and will be tomorrow more desirable than another use, such preferences are valid, but they should be periodically reviewed in order to keep abreast of modern thinking.[83]

In some situations, flexibility may be thought to demand the transfer of water from one use to another without the payment of compensation, whatever the cost in loss of stability of investment. There are a few examples of such true preferences, by which a new preferred use is placed at the top of the priority list and may be initiated without regard to the fact that the supply is already fully appropriated for other purposes.[84] In Texas, since 1931, for example, all appropriations (except of the Rio Grande) are granted subject to future appropriations for municipal purposes.[85] Several interstate compacts also declare that the impounding and use of water for hydroelectric power will be subservient to the use and consumption of water for agricultural and domestic purposes.[86] And the federal government has

[80] See ELWOOD MEAD, IRRIGATION INSTITUTIONS 174 (1903).

[81] *Cf.* NAT'L RESOURCES PLANNING BOARD, *op. cit. supra* note 62, at 45 (1943).

[82] See Trelease, *supra* note 48.

[83] *Ibid.*

[84] *Ibid.*

[85] TEX. REV. CIV. STAT. art. 7471 (1948).

[86] Colorado River Compact, 45 STAT. 1064 (1928), 43 U.S.C. §617l (1952); Upper Colorado River Basin Compact, 63 STAT. 31 (1949), 43 U.S.C. §617l note (1952); Snake River Compact, Act of April 21, 1950, 64 STAT. 29 (1950).

given assurance that the use of western waters to maintain flowing navigation channels will not conflict with present or future beneficial consumptive uses.[87]

If there is doubt as to the wisdom of granting a perpetual right to a certain use or type of use, and yet it is thought desirable to avoid absolute loss of stability, one available device is a permit for a specified limited time, during which the appropriator may recapture his investment through amortization. Examples of this technique are appropriations for power purposes in South Dakota and Arizona, limited to fifty and forty years, respectively.[88]

Another type of appropriative flexibility, again without compensation, consists of abandonment and forfeiture. As old rights fall into disuse, usually because of economic unsuitability, they cease to exist. An appropriative right may be lost by abandonment, which consists of the voluntary relinquishment and nonuse of a water right, coupled with an intention not to renew the use of the water.[89] A number of states have adopted a different concept, that of forfeiture, and provide that failure to use water for a certain period of time will result in the loss of the right, regardless of the intent of the owner,[90] although forfeiture statutes are not generally applied when the nonuse is involuntary and not attributable to the neglect of the appropriator.[91]

V

PROTECTION OF PUBLIC INTERESTS

An ideal system of water use law should give protection to two types of public interests—the interest in the protection against exploitation and waste of water resources, including the interest in obtaining optimum development and seeing that water is put to the best possible use, as well as the interest held collectively by members of the public in such uses of water as navigation, fishing, and recreation. When tested by this criterion, neither the substantive law of appropriation nor the substantive law of riparian rights seems to hold any marked advantage over the other. Both systems have concepts designed to curb the wasteful use of water, although the riparian ideal of reasonable use is based primarily on the question of how much damage the use will inflict upon private interests,[92] while the fairly new appropriative concept of "reasonable beneficial use" does place emphasis upon the public interest in the economic use of the water.[93] Nevertheless, courts dealing with riparian rights have looked to the general public interest in full utilization of the waters in some cases, in which they have held that a riparian must suffer some damage from another riparian's use in order that full use of scarce supplies can be made.[94] Riparian

[87] This is the O'Mahoney-Milliken Amendment to the Flood Control Act of 1944, 58 STAT. 887, 33 U.S.C. §701 (1952).

[88] S.C. CODE §61.0152 (1952); ARIZ. CODE ANN. §75-111 (1939).

[89] See HUTCHINS, *op. cit. supra* note 77, at 389.

[90] *Id.* at 392.

[91] Ramsey v. Gottsche, 51 Wyo. 516, 60 P.2d 535 (1937).

[92] See RESTATEMENT, TORTS §852 (1939).

[93] See NAT'L RESOURCES PLANNING BOARD, *op. cit. supra* note 62, at 40.

[94] Rancho Santa Margarita v. Vail, 11 Cal.2d 501, 81 P.2d 533 (1938).

doctrines have also been successful in preserving to the public rights to navigation and fisheries.[95]

One technique used to a limited degree in the West, however, may offer possibilities unobtainable under riparian law. To the extent that it is possible to forecast benefits from a long-range use that will exceed those from more immediate uses, waters may be reserved from appropriation to save them for the future use. A potential project may be conceived long before actual need arises, and a large and comprehensive development may wait years before final plans can be drawn or financial arrangements made. If such a project constitutes the most desirable and economic use of a large part of the waters of the source of supply, it may be jeopardized by less desirable appropriations capturing substantial quantities of water before it can be initiated. In order to protect such potential developments, therefore, the Utah statutes authorize the governor to suspend the right of the public to appropriate the waters.[96] Where recreational interests in a particular stream are regarded as paramount, the same technique has been used. In Oregon, many streams that form beautiful falls or that are famous fishing waters have been reserved from appropriation;[97] and in Idaho, the governor has been authorized to appropriate the waters of certain lakes in trust for the people in order to preserve them for their scenic beauty, health, and recreational values.[98]

The procedures that have been developed to administer appropriation law, as distinguished from the substantive law, offer many advantages for protecting the public interest over the typical court enforcement of riparian rights. The courts are not an adequate agency for insuring the optimum community benefits from water resources;[99] it has been pointed out that the adversary process rivets the court's attention to the particular parcels of land in dispute and is not well designed for assisting the court to reach the best conclusion regarding social policy and the public interest.[100] One major defect in riparian administration is that it is *ex post facto*, in that lawsuits do not ordinarily arise until both competing uses are in operation. In contrast, in all but three of the seventeen western states, no use of water can be initiated except upon application to state water officials for a permit, which may be denied if there is no unappropriated water. In addition, the administrators may deny the permit if the proposed use would conflict with the public interest.[101] The water administrators of several states have the power to choose among pending applications that seek to appropriate from the same supply when the available water is insufficient for all—in some, according to a fixed list of preferences,[102] in some, on broad discretionary grounds relating to maximization of benefits from the use of the water.[103] Not only may applications for appropriations be denied as contrary to the public interest, they may be subordinated to projects promising greater benefits,[104]

[95] See Arens, *supra* note 40.
[96] UTAH CODE ANN. §73-6-1 (1953).
[97] ORE. REV. STAT. §§538.110-538.300 (1955).
[98] IDAHO CODE ANN. §§67-4301, 67-4304 (1949).
[99] See Arens, *supra* note 40.
[100] Haar and Gordon, *supra* note 9.
[101] See Lasky, *supra* note 8.
[102] See Trelease, *supra* note 48.
[103] *Ibid.*
[104] Tanner v. Bacon, 103 Utah 494, 136 P.2d 957 (1943).

or they may be issued subject to conditions or restrictions dictated by public interest.[105]

It has been noted that this technique has been little used, that very few cases of denials of permits on public interest grounds have reached the courts.[106] This seems to be a very desirable state of affairs, rather than an indication that the procedure is an ineffective one. Most uses of water that have been made in the past, when regarded individually, have desirably added to the wealth of the user and of the community. The use of water to unlock the mineral wealth that drew the early pioneers, to make possible the western agricultural economy, its use for municipal needs, power, and stockwatering could all be said to fit into the public interest in the development of the West. State regulation has been a stand-by power; the need for its exercise may grow as maximum development approaches.

In some of the eastern states with the riparian system, there are provisions requiring permits for the use or for certain uses of water. These, however, seem to operate on a much more restricted scale than do the western permits. For the most part, the permits issued under these laws seem to be certificates to riparians that their proposed uses are not against the public interest, and the public interest protected seems to be principally the maintenance of minimum streamflows. Such permits as have been issued to nonriparians are construed as giving no rights against riparians. Their administration seems to have had no substantial effect upon riparian rights, nor have administrators attempted to use them so as to give any effect to priority of appropriation.[107]

VI

THE PROBLEM OF UNUSED RIPARIAN RIGHTS

In theory, at least, a water law that gives effect to unused riparian rights seems to violate nearly all of the standards for optimum river basin development. These rights constitute the main threat to nonriparian and out-of-watershed development, they are the principal cause of insecurity of existing riparian uses, and their presence adds greatly to the cost of obtaining firm water rights under a riparian system. They are unrecorded, their quantity is unknown, their administration in the courts provides very little opportunity for control in the public interest. To the extent that they may deter others from using the water for fear of their ultimate exercise, they are wasteful, in the sense of costing the economy the benefits lost from the deterred uses. Their main advantage, that of flexibility, can be better obtained by other methods.

Unused riparian rights may still present problems in the western states of California, North Dakota, Oklahoma, and Texas,[108] and they present an apparent prob-

[105] East Bay Municipal Utility Dist. v. Dep't of Public Works, 1 Cal.2d 476, 35 P.2d 1027 (1934); Kirk v. State Board of Irri., 90 Neb. 627, 134 N.W. 167 (1912).

[106] Fisher, *supra* note 33.

[107] See Ellis, *supra* note 9. Marquis, Freeman, and Heath, *supra* 9, suggest that these eastern permits statutes could have a broader significance and could even be used to introduce an element of priority.

[108] See Trelease, *supra* note 58.

lem in all of the eastern states except Mississippi.[109] How serious a problem this is, in fact, is difficult to determine except on the basis of local study.

Most recent reforms and proposals for water law reforms have centered about some variation of a plan which would protect all existing riparian uses of water as "vested rights," but would provide that all future uses of water shall be by virtue of priority of appropriation, subject to regulation by the state.[110] Over this plan, the controversy rages, often tinged with emotionalism.[111] Defenders of riparianism cry out at this destruction of property.[112] And it is admitted that these rights may have real value, as representing claims to a future water supply; they may even represent actual investment, if riparian land has been purchased at a price which includes the potential value of the underdeveloped rights. To destroy such values would run counter to one of the major principles outlined above—security of investment in water rights.

But would such rights be "destroyed"? For the most part, there are still excess

[109] See Ellis, *supra* note 9. Mississippi has eliminated unused riparian rights and substituted a system of appropriation. MISS. CODE ANN. §§5956-01 to 5956-30 (Supp. 1956).

[110] This proposal is known as the "Oregon plan" and has been in force in that state since 1909. ORE. REV. STAT. §539.010 (1955). It was adopted by Kansas in 1945, KAN. GEN. STAT. §§82a-701 to 82a-722 (1949); by South Dakota in 1955, S.D. Laws 1955, c. 430, p. 506; and by Mississippi in 1956. *Supra* note 109. The Kansas statute is subject to the possible construction that unused riparian rights nullified by appropriations may have to be paid for. In Nebraska, which adopted a statute permitting appropriations in 1889 without stating its effect on riparian rights, it was held that an appropriator might take the riparian's water as if by condemnation, that a riparian could not enjoin an appropriative use, and that his damages for loss of unused riparian rights was nominal only. Crawford Co. v. Hathaway, 67 Neb. 325, 93 N.W. 781 (1903); McCook Irri. & Water Power Co. v. Crews, 70 Neb. 109, 96 N.W. 996, 102 N.W. 249 (1905); Cline v. Stock, 71 Neb. 70, 98 N.W. 454 (1904), 71 Neb. 79, 102 N.W. 265 (1905). This limitation of remedies accomplished the same results as the Oregon-plan statutes. Washington, which had a similar duplicity in its laws, reached the same end by holding that waters were free for appropriation if not beneficially used by the riparian within a reasonable time. Brown v. Chase, 125 Wash. 542, 217 Pac. 23 (1923); *In re* Sinlahekin Creek, 162 Wash. 635, 299 Pac. 649 (1931). For a more detailed treatment, see Trelease, *supra* note 58, at 60-65.

[111] *E.g.*, Mann, *Riparian Irrigation Rights as Declared and Enforced by the Courts, and Protected by the Statues, of Texas*, in PROCEEDINGS OF THE WATER LAW CONFERENCES, UNIVERSITY OF TEXAS 169 (1954).

[112] The constitutionality of the plan, as against "due process" objections, has been discussed in such detail as to require only a reference to the literature. See Trelease, *supra* note 58, at 62-67; Marquis, Freeman, and Heath, *supra* note 9, at 32-35; Coates, *supra* note 9, at 286-96; Fisher, *Due Process and the Effect of Eastern Appropriation Proposals on Existing Rights*, in SYMPOSIUM ON THE LAW OF WATER ALLOCATION IN THE EASTERN UNITED STATES (to be published by the Conservation Foundation 1957). To the cases therein cited should be added a recent decision by a three-judge federal court, affirmed without opinion by the United States Supreme Court. Baumann v. Smrha, 145 F. Supp. 617 (D. Kan.), *aff'd*, 352 U.S. 863 (1956). In upholding the Kansas statute, *supra* note 110, in so far as it related to regulation of ground-water, the court said, at 624-25: "The power of a state either to modify or reject the doctrine of riparian rights because unsuited to the conditions in the state and to put into force the doctrine of prior appropriation and application to beneficial use or of reasonable use has long been settled by the adjudicated cases.

"Of course, such a modification in the law of the state must recognize valid existing vested rights, but we do not regard a landowner as having a vested right in underground waters underlying his land which he has not appropriated and applied to beneficial use.

"We hold that the state could properly apply the doctrine of prior appropriation and application to beneficial use to unused and unappropriated waters so long as it recognized and afforded protection to rights which landowners had acquired at the time of the effective date of the Act to appropriate and use water."

waters in the states with unused riparian rights. Such a statute would not automatically cut off the riparian from all participation in the stream; although he would lose the exclusive nature of his privilege, he might still obtain water for his use via the appropriation method. It is true that there would be a time limit upon the privilege, which could only be exercised up to the point when by his use he would deprive another person of the latter's water and investment. If this period were felt to be too short or too indefinite, the riparian might be given the privilege of becoming an appropriator for a specified time[113]—in effect, giving him a preference to the use of the water during that period.

On the other hand, it might be found practically or politically expedient to retain the unused riparian right in some form, yet still obtain advantages from an appropriation system to control nonriparian uses. Studies might prove that in some states or areas, the amount of riparian land is so small in relation to the amount of water in the streams that riparian rights might be exercised at will, with the appropriation law regulating only nonriparian uses.[114] Or it might be found that riparian lands presented the most desirable sites for future development, justifying such a reservation in their favor. Or legislative adoption of restrictive interpretations of riparian rights might free much water for nonriparian appropriation by limiting the quantity of riparian land, the water the riparian might claim, the uses deemed reasonable, and by broadening doctrines of prescription and estoppel.[115] Some measure of certainty, moreover, might still be introduced by the adoption of appropriation principles and devices. One such device might be to put such claims on record by an adjudication procedure—to fix them in quantity so that at least the maximum riparian demands on the stream might be determined, from which the nonriparians could then calculate the availability of water for their development.[116] And as a final resort, if the public interest demands both protection of the unused riparian right and freedom of development from such claims, they could be made subject to condemnation.[117] This solution has the serious drawback of requiring the developing agency to pay not only the cost of its project, but also the value of the hypothetical uses the riparian might make of the water, an added expense that could be substantial enough to render the project infeasible.

[113] The 1956 Mississippi statute does not take effect until April 1, 1958. MISS. CODE ANN. §5956-04 (Supp. 1956).

[114] This would approximate the present California law. Peabody v. Vallejo, 2 Cal.2d 351, 40 P.2d 486 (1935); Meridian, Ltd. v. San Francisco, 13 Cal.2d 424, 90 P.2d 537 (1939).

[115] See Trelease, *supra* note 58. In Texas, this has been done administratively. Board of Water Engineers Reg. 520.2 (1953).

[116] See notes 67-71 *supra*. For the constitutionality of such procedures, see O'Neil v. Northern Colorado Irri. Co., 242 U.S. 20 (1916); Pacific Live Stock Co. v. Lewis, 241 U.S. 440 (1916).

[117] Private rights of eminent domain could raise other problems. *But. cf.* Clark v. Nash, 198 U.S. 361 (1905). Public districts and development agencies could, however, exercise such powers to accomplish much.

VII

CONCLUSION

In the introduction to this article, emphasis was placed upon the importance of state water law as a force affecting river basin development. This premise may be based upon a fallacious assumption about human behavior, a fallacy into which law-trained men may easily fall. Perhaps the law does not play so important a part in governing the affairs of men; perhaps there is a tendency for men to act on the assumption that everything will come out all right in the end—the lawyers will straighten out the details. A person trained in another discipline, an engineer, has postulated that, in fact, water laws have a relatively unimportant effect on development, that entrepreneurs initiate projects and engineers build them without much regard for the fears here discussed.[118]

Perhaps the truth lies somewhere between. If poorly-designed laws do not impede all developments, how much do they impede? If development proceeds outside the law, to what extent is present law a trap waiting to be sprung on those who have invested in projects? How many projects are not built? The biggest builder and financier of water-use projects, the federal government, has refused to act in the face of uncertain water titles. A large project in Kansas, for example was delayed until the validity of that state's law subordinating riparian rights to appropriations was determined;[119] the Boulder Canyon Project Act for the construction of Hoover Dam provided that it would not be operative until certain interstate differences were settled;[120] and later, the states of the upper Colorado River Basin gladly hurried into a compact dividing the water among themselves when they were informed that the final selection of federal reclamation projects would depend upon a firm allocation of the waters.[121] And in an analogous field, Congress has required that internal state law must meet a federal standard; the Colorado River Storage Project Act of 1956, in effect, limits irrigation benefits to states whose laws provide for the organization of conservancy districts.[122]

Whether the threat of federal nonspending is regarded as a carrot or a stick, it can act as a powerful inducement for a state to review its water laws. Aside from such consideration, the states should seriously study the need for revision of their laws. It is easy to be complacent about water law, to adopt a wait-and-see attitude, to say that there is no present emergency crying for action. But if this attitude is taken, the state may never know what it has lost through the lack of development.

Nor does the fact that a state has the prior appropriation doctrine as the basis of its law give it grounds for complacency. A watershed restriction that prevents

[118] Wolman, *Remarks*, in SYMPOSIUM ON THE LAW OF WATER ALLOCATION IN THE EASTERN UNITED STATES (to be published by the Conservation Foundation 1957).

[119] State *ex rel.* Emery v. Knapp, 167 Kans. 546, 207 P.2d 440 (1949).

[120] 45 STAT. 1058 (1928), 43 U.S.C. §617c(a) (1952).

[121] U.S. BUREAU OF RECLAMATION, THE COLORADO RIVER 185 (1946).

[122] 70 STAT. 105 (1956), 43 U.S.C.A. §§620-620(o) (Supp. 1956).

bringing water to the place of need is as much of a hindrance to development in Colorado as in New York. An unused appropriation that can be reinstated at will is as serious a threat to the security of a new right as is an unused riparian right. A preference for irrigation surviving from pioneer times or a jealous tying of water to agricultural land forever can prevent the industrialization of some parts of the West. Not all western states have adequate procedures for protecting private and public interests.

It is not necessary that the course of future development be exactly foreseen. If present impediments to maximum and optimum development can be identified and removed, if a framework is provided that will protect present uses, aid and encourage future desirable uses, and supply means for preventing undesirable uses, it will be enough.

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